Research Report
2005-2009
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Télécom ParisTech / LTCI

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Laboratoire Traitement et Communication de l'Information - UMR 5141
Télécom ParisTech - CNRS

Communications and Electronics

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Contents

Communications and Electronics (COMELEC)

The research led in the **Communications and Electronics** department is devoted to the physical layer of ICT (Information and Communication technology). A useful concept for depicting the department main research concern is that of "physical information", where the information content is actually reached through some physical properties and manipulated using physical laws such as Maxwell electromagnetic equations or Quantum Hamiltonians. The department covers both the field of communication and that of information processing (electronics).

The department accounts for 36 permanent research staff and hosts about 90 non permanent researchers, including PhD students. The research activity is covered by four different teams. While fixed communications are dealt with by the **Optical communication group**, the **Electronics and RF systems team** concentrate on the transformation from analog to digital information and to its transmission through wireless means. The **Digital communications team** works on the digital coding of the information, and prepare for the future digital communication breakthrough in MIMO system, multi-hop communications or multi-users wireless communications. Processing information requires extremely sophisticated Silicon chips (processors, FPGAs, SOCs), the architecture of which is central to the **Complex Digital Electronics system team**. Transverse to all these activities, one may also find security as a main topic.

The department research policy claims for a research effort that spreads from fundamental physics to applied results. One may for example note the use of quantum dots for optical clock recovery (see the optical communication team) or that of photonic crystal (also called metamaterial) for advanced antennas (Electronics and RF Systems team). The balance between exploratory research and market oriented results is well expressed by the 1:4 ratio between our private partners funding and our total research contract income (7 Meuros cumulated over the period). Because of an innovation minded research taking its roots in fundamental theories, the department was granted 29 patents while publishing over 550 papers in journals and conferences in the evaluation period.

The department is also strongly involved in educating students for research. This is reflected by the 70 defended PhD thesis over the period. A budget of about 75 keuros is also spent yearly for master student internships in the department research groups, with a total of about 150 man.month of internship generated every year. Besides its contribution to the "ingenieur courses" of TELECOM ParisTech, the department researcher's participate to master courses with ParisVI, ParisXI, as well with the University of Nice.

In terms of outreach, the department was strongly involved in a number of initiatives both at local, national and international levels. Among other actions, one may notice the Electronics and RF systems team involvement in the creation of the GIS Esys "Groupement pour l'Electronique des Systèmes" led by Supelec. The Complex Digital Electronics system team initiated the Sophia-Antipolis Formal Analysis group SAFA and recently animated its first workshop. The Electronics and RF systems team was also a recognized actor in the launching of the joint IEEE Newcas-TAISA conference. Of interest, a world open contest on electronics attacks was launched by the Complex Digital Electronics system team at the CHESS meeting. In order to help for a better European visibility, the department head created and chaired the IDEA League (Imperial College,

Delft University, Eth Zurich, Aachen RWTH) ICT cluster. As an international impact indicator, the department teams are currently involved into two European STREPS, three European NOE's, one Eureka program and lead a Carnot-Fraunhofer project.

Faculty [IT, CNRS]	[29.75, 2.75]
PhD students	48.5
Post-docs, engineers and sabbaticals	10.75
Defended PhD theses	70
Defended HDR	4
Journal papers [published, in press]	[143, 18]
Papers in conference proceedings	410
Chapters and books	10
Patents and software	[29, 5]
Grants [public, private, european] (k€)	[4731, 1902, 417]

Chapter 1

Digital Communications (COMNUM)

Team leader Jean-Claude Belfiore (P).

Faculty

Jean-Claude Belfiore (P), Joseph Boutros (MC, –07/07), Philippe Ciblat (MC), Walid Hachem (CR CNRS), Ghaya Rekaya-Ben Othman (MC), Olivier Rioul (MC), Georges Rodriguez (MC), Aslan Tchamkerten (MC, 09/08–).

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Post-docs and engineers

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Sabbaticals

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External collaborators

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Faculty [IT, CNRS]	[5.8, 0.7]
PhD students	13
Post-docs, engineers and sabbaticals	1.3
Defended PhD theses	22
Defended HDR	1
Journal papers [published, in press]	[38, 6]
Papers in conference proceedings	98
Chapters and books	3
Patents	10
Grants [public, private, european] (k€)	[377, 512, 95]

1.1 Objectives

The Digital Communication team is traditionaly working in what is called the physical layer of a network, that is, how to reliably transmit data from one point to another one. In order to achieve that, many techniques are used,

- Information theory to establish the fundamental limits of the system
- Signal processing to address problems related to synchronisation, channel estimation, modulation techniques such as OFDM or Ultra WideBand
- Channel Coding covering two aspects. One of them is the traditional channel coding with redundancy and the other one uses tools from number theory in order to find the right geometrical transforms that will give diversity in wireless systems.

During the last years many evolutions of this area have given rise to the study of a more complex problem than the point-to-point communication. It has started with the use of multiple antennas at both the transmitter and the receiver, the so-called MIMO systems.

Starting from this problem, many other ones appeared among which cooperative communications, multi-user communication systems or more generally, wireless networks. Many nodes in a wireless network want to communicate data to other nodes helped by a third group of nodes (through multihop communication). The digital communications team has followed this evolution by working on MIMO systems, on cooperative systems and on multi-user communications where we consider many data flows instead of a single one.

A last part is devoted to statistics for communication seen as a tool for analysis and for parameter estimation.

Notice that our research activities are always supported by national, european or industrial fundings. In addition to these activities, the team has an intense activity in terms of teaching for the Engineering school as well as for Research Masters. We especially are the leader for the Research Master, called ESCO/STN, in collaboration with Université Pierre et Marie Curie.

1.2 Main Results

The main research results obtained during the period 2005-2009 are presented below.

1.2.1 Coding and Decoding for MIMO Systems

Faculty J.-C. Belfiore, J. Boutros (–07/07), G. Rekaya - Ben Othman

Main events Organisation of NEWCOM Autumn School on "Space-Time Coding" which took place in Turin in 2006 with 25 attendees. Jean-Claude Belfiore was the recipient of "Médaille Blondel" in 2007 for the invention of "Golden Codes". Ghaya Rekaya Ben Othman was the recipient of "Jeune Chercheuse parisienne" award in 2006.

Projects ANR XCODES, CIFRE MITSUBISHI, CIFRE THOMSON

Space-Time Coding Space-Time coding techniques have been successful and widely used these last years. Some Space-Time codes have been integrated in several standards like the 3GPP (HSDPA), the Wifi (standard IEEE 802.11n) and Wimax (standard IEEE 802.16e). Our team is widely recognized in the world for its works on Space-Time codes. After the celebrated "Golden Code", proposed for 2 transmit antennas MIMO systems, we have extended this construction to a larger number of transmit antennas, using the fantastic tool of cyclic division algebras [148]. Thess new codes have been called "Perfect Codes" [36], and include the Golden Code as a special case. In the context of impulse Ultra WideBand (UWB), the complex envelope of the transmitted signals is real. We have developed real Space-Time codes adapted to the UWB context [3, 1, 5, 4]. A new space-Time code called the "Silver Code" has been recently proposed for the 2×2 MIMO channel. This code has a low decoding complexity compared to the Golden code. We have found the algebraic structure of this code (an ideal of an order of a cyclic division algebras) [118].

Variations on the Golden Code Space-Time codes were constructed to exploit all the degrees of freedom of the MIMO channel, in terms of diversity and multiplexing gain. In practical applications, these codes are concatenated with error correcting codes such as turbo-codes or LDPC. To analyze the performance of these codes in a practical context, we have studied the integration of the Golden Code in the MIMO-HSDPA [108] and in the WiFi 802.11n [101]. For the MIMO-HSDPA, it was proven that the Golden code offers the best performance compared to the best scheme having the same rate and the same diversity order. For the Wifi, the Golden code have almost the same performance as the other codes, this is explained by the high frequency diversity provided by the convolutional code compared to the diversity provided by Space-Time Code. We have also considered the case of correlated antennas at the emission side. The performance of the Golden code in this context are deteriorated. We have so proposed a linear precoder taken into account the correlation [122]. We have also studied the use of the Golden code and the 4×4 Perfect code in the case of very slow fading channel (channel constant during more than 50 time slots). We have proposed a partition of the Golden code and the 4×4 Perfect code function of the minimum determinant, and a coding and decoding scheme concatenating the Space-Time Code with Treillis codes [127, 23]. These partitions provide an important gain compared to the simple Golden Code. We was also interested to the use of the Golden code in the case of slow fading channel (channel constant during less than 50 time slot). We have propose in this case a coded modulation scheme combining the Reed-Solomon code and the Golden code that maximize the minimum determinant [33]. Very good performance was obtained compared to the simple Golden code.

MIMO Decoding Algorithms MIMO (even distributed) schemes with or without linear Space-Time codes have a lattice representation which allow their decoding using lattice decoders. The most known and used lattice decoders in the literature are the sphere decoder and the Schnorr-Euchner algorithm. Both decoders offer ML performance but have a complexity which dramatically increases with the lattice dimension and constellation size. We have studied the sequential algorithm called "stack decoder", which is a tree search algorithm under a cost function constraint, originally proposed in the literature to decode convolutional code. We have proposed a

new decoder, called "SB-stack", which uses the tree search strategy of the stack decoder (best first search strategy) and the search region of the sphere decoder (a sphere centered on the received signal). This new algorithm have ML performance, but is 30% less complex than the sphere decoder. By introducing a bias parameter (b) in the cost function, the SB-stack offers a range of performance going from ML ($b = 0$) to ZF-DFE ($b \to \infty$), with decreasing complexity. We also modified the SB-stack to get soft outputs, necessary if the Space-Time code is concatenated with channel coding. A patent on the SB-Stack has been registered [159]. In practical application, a variable decoding time could be a big problem, for example for real-time applications. To solve this problem we have proposed an adaptive decoding scheme, giving rise to another patent [158]. The idea of this adaptive decoding is to choose the most appropriate decoder (optimal or sub-optimal) as a function of the channel quality and the desired performance. We observed, through simulation results, that the decoding complexity remains constant for all channel realizations and for all signal to noise ratios.

Up to now, decoding of algebraic space-time codes has been performed using their lattice representation. The algebraic structure of the code has completely been ignored at the receiver side. We have been able to exploit the algebraic structure of the code even at the decoding side. We have proposed a new decoding method for 2×2 space-time codes constructed from quaternion algebras (like the Golden code) which directly exploits the multiplicative structure of the space-time code in addition to the lattice structure [120]. This method, called "algebraic reduction", consists in making the code absorbing most of the channel. This is done by approximating the channel matrix by a unit of a maximal order of the associated quaternion algebra. In the quaternionic case, the Swan algorithm can be used to find a finite set of generators of the unit group, by considering its action on the hyperbolic 3-space H_3. Supposing that this set is known, we develop a searching algorithm to find the best approximation of the channel matrix as a product of these generators. For the Golden Code case, simulation results show that using MMSE-GDFE left preprocessing, the performance of algebraic reduction with ZF decoding is within 3dB of the ML. However the complexity of the algebraic reduction is negligible compared to the ML decoder. A patent on this algebraic reduction has been registered [157].

1.2.2 Multihop Communications

Faculty J.-C. Belfiore, P. Ciblat, W. Hachem, G. Rekaya - Ben Othman

Main events Jean-Claude Belfiore was Technical Track Chairman for conference IEEE PIMRC in 2008. Jean-Claude Belfiore was Publications Chairman for conference IEEE ISIT in 2007.

Projects ANR RADIC-SF, ANR ORIANA, Pôle SYSTEMATIC/ URC Project, CRE FRANCE TELECOM, CIFRE FRANCE TELECOM

New Protocols for Relaying Schemes In the literature two main kinds of relaying protocols exist: Amplify-and-Forward (AF), and Decode-and-Forward (DF). Some other approaches, such as Dynamic DF (DDF) or Compress-and-Forward (CF), have been introduced in the literature, but we did not consider them in our work because of their high computational load. We remind that the relay only applies a linear operator on the receive signal before to re-transmit it in AF based protocols. In DF based protocols, the relay attemps to decode the data, and re-encodes them if data have been decoded. We have proposed two significant improvements to such protocols.

Amplify-and-forward cooperation is an attractive scheme probably because of its low relaying complexity and its nature of linearity. We have shown that it is indeed efficient and optimal in various scenarios as far as the diversity is concerned. Using the diversity-multiplexing tradeoff (DMT) as our evaluation tool, two scenarios are considered : the large network scenario and the small network scenario. In small networks, the non-orthogonal amplify-and-forward (NAF) scheme has been first studied. It has been generalized to the MIMO case, where upper and lower bounds on the DMT the NAF scheme have been derived [43]. The same NAF has been successfully used on UWB systems [6]. All the known half-duplex cooperation schemes, including

both the class of decode-and-forward and amplify-and-forward schemes, are inefficient in the high multiplexing gain regime. With multiple relays, we have shown that the diversity gain can be improved by letting as much the source signal as possible be forwarded by the relays. A simple sequential slotted amplify-and-forward scheme has been proposed [44]. It is shown that this scheme tends to the cut-set bound in some particular cases when the number of slots goes to infinity. The proposed AF cooperation schemes have equivalent MIMO or parallel MIMO channels representation. Both construction criterion and implementation of approximately universal codes have been developed [43, 138].

Concerning DF, we propose a half-duplex single-relay protocol called *Decode or Quantize and Forward* (DoQF). The added quantification step occurs when the relay did not succeed to decode its receive signal. Instead of being silent, the relay sends a quantized version of its receive signal to the destination. The new protocol has been analysed over slowly fading wireless channels. In this context, a relevant performance index is the so-called Diversity gain-Multiplexing gain Tradeoff (DMT). We proved that the DMT of the proposed DoQF relaying protocol, which is a static protocol characterized by a practical receiver structure, achieves the 2×1 Multiple Input Single Output (MISO) upperbound for small multiplexing gains. DoQF protocol thus outperforms the classical non orthogonal Decode-and-Forward (NDF) protocol in terms of DMT. To prove the benefit of the proposed method, we also derived the outage gain which is defined as follows: the term $\rho^2 P_o$ converges to a constant ξ when the SNR ρ tends to infinity and N represents the number of relays. This constant ξ will be referred to as the outage gain. We showed that the DoQF protocol is optimal in terms of outage gain in a wide class of half-duplex relaying protocols [58]. We also studied the outage probability behavior in the context of multi hop communications where the relays are not synchronized. AF as well as DF protocols were considered [105].

Power and Time Optimisation in Relaying Schemes In the context of cooperative wireless networks that convey data on slow fading channels, several protocols that define how the source the relays and the destination have to operate, have been proposed in the literature. One can mention, as already done above, AF, NAF, SAF (proposed by our team), DF, NDF, DoQF (proposed by our team), DDF, etc. When the channels realization are unknown at transmitter sides, these protocols have been extensively analysed in terms of DMT. Nevertheless DMT criterion does not provide insights about the total power distribution between the source and the relays since this criterion is insensitive to that distribution. Moreover each frame defined in any protocol is divided into several time slots. Often these time slots have equal durations for sake of simplicity. Our main contribution was to provide solutions to the optimization problem of power distribution and time slots durations. To do that, as DMT criterion is not efficient, we suggested to only focus on the outage probability P_{o} when the required data rate is fixed. However, it is often hard to derive a closed-form expression for P_{o} valid for any value of the Signal to Noise Ratio (SNR). The problem can be simplified by studying the behavior of P_{o} in the asymptotic regime where the SNR ρ converges to infinity. In this regime, usually $\rho^{N+1} P_{\mathrm{o}}$ converges to a constant ξ where N is the number of relays. We have proposed a simple and general method for deriving and minimizing ξ with respect to the power distribution between the source and the relays, and with respect to the time slots durations specified by the relaying protocol when transmitters only have a statistical knowledge of propagation channels. While the proposed approach is designed for the high SNR regime, we showed that outage probability is reduced in a similar proportion at moderate SNR. Notice that AF, NAF, DF, NDF, and DoQF have been handled. Moreover the method applies to a general class of radio channels that includes the Rayleigh and the Rice channels as particular cases. Last but not the least, we proved that ξ is convex with respect to the design parameters which leads to a simple optimization algorithm [22].

Analysis of Multi-Hop Communication Schemes Without Direct Link Notice that all previous works have done under the assumption that a link (even weak) exists between the source and the destination. When this assumption is not satisfied, a lot of previous works fall down, and a new analysis has to be done. In large networks, requiring the relay terminals to decode the source

message imposes a harsh constraint and limits the achievable multiplexing gain in general, especially when the source and the destination have multiple antennas. A naive amplify-and-forward scheme is space-only processing that achieves the maximum multiplexing gain but suffers from diversity loss. By introducing a simple temporal processing, a flip-and-forward scheme achieves both the maximum diversity and maximum multiplexing gain provided by the channel. It is the best known cooperative scheme in this scenario, in terms of the DMT [46].

1.2.3 Multi-User Communications

Faculty J.-C. Belfiore, P. Ciblat, W. Hachem, G. Rekaya - Ben Othman

Main events Philippe Ciblat served as Associate Editor for IEEE Communications Letters during the period 2004-2007.

Projects ANR RISC, CIFRE THALES, CIFRE MOTOROLA, CRE FRANCE TELECOM, Network of Excellence NEWCOM and NEWCOM++

Analysis of Impulse Radio UWB in Multi-User Environment In multi-user environment, the rake receiver for UWB modulated signals offers poor performance because of the multi-user interference which may be significant. One mean to reduce the level of multi-user interference is to design the multi-user codes properly. Therefore, we have focused intensively on the characterization of the "good" multi-user codes and of the "bad" multi-user codes in impulse radio UWB based on either time-hopping (TH) or direct sequence (DS) multiple access.

First of all, we showed that the multi-user interference assuming fixed multiple access codes can be well approximated by a Generalized-Gaussian Distribution whatever the multipath channel model. Then, thanks to this approximation, we derived an accurate closed-form expression for an approximation of the error probability in both TH and DS multiple access context. Note that the analytical expression for the error probability depends on the real multiple access code.

Secondly, from this error probability approximation, we were able to characterize and to select the set of codes minimizing the error probability for both multiple access techniques. Notice that the set of codes minimizing the power of the multi-user interference is an upperset of the set of codes minimizing the error probability. The merit of each multiple access technique has been then analyzed: we especially proved that the probability to find an optimal pair of codes goes to one when increasing the number of chips per symbol with TH technique whereas this probability goes to zero with DS technique. Therefore we advocated to employ TH technique rather than DS technique [92]. The study of a MIMO multiuser system has been proposed in [4].

Analysis of OFDMA Based Systems in Multi-Cell Environment In the context of Frequency-Hopping OFDMA with a frequency reuse factor equal to one, we have analysed the influence of the multi-cell interference on the performance for the downlink situation. We have assumed that the channel is unknown at the transmitter, but that the channel statistics are available. Furthermore, as frequency-hopping scheme is carried out, we have considered that the ergodic capacity was a accurate approximation of the achievable data rate. Firstly, under the assumption that the base stations combat the multi-cell interference by increasing their own power in order to satisfy the target data rate of their users, we have shown that it exists one power value for which the multi-cell system is stable if the target data rate are lower than a certain value playing the role of a "capacity". Moreover the subcarrier and power assignment per user has been optimized [16]. Secondly, to be more realistic and to satisfy the recommendation of Wimax forum, we then assumed that a certain part of the available bandwidth may be reused by different base stations (and is thus subject to multicell interference) and that an other part of the bandwidth is used by one base station only (and is thus "protected" from multicell interference). In such a context, we proved that all the subcarriers of one user will be either on the protected bandwidth or on the shared bandwidth. We thus proved that the naive idea of separating bandwidth into two classes

is optimal ! Thanks to an asymptotic analysis for which the number of users was considered to tend to infinity, we were also able to characterize the optimal frequency reuse factor in closed-form [95].

We have studied power and frequency allocation in a distributed OFDMA cellular context [38]. We have established a convergence criterion in the SISO case [37], which has been extended to the MIMO case [114], for rate constrained users. This study has been done for perfect Channel Side Information at transmitters (**CSIT**), but also for statistical CSIT, for which a new expression of the outage probability has been derived. Then, the case of Best efforts users has been considered, still for OFDMA distributed cellular networks. In the literature, only the case of the high SNR regime has been considered. We gave a new method for.

Resource Allocation in OFDMA Based Systems Multi-user systems based on OFDM are frequently used in powerline or quasi-static wideband wireless channels. Typical scenarios assume that precise channel state information can reasonably be obtained at the transmitter and at the receiver. In downlink, a spectral mask constraint is usually imposed too. In such previous context, we assumed two multiple access schemes, MC-DS-CDMA and a simpler OFDMA, and we have investigated their achievable-rate regions. In particular, we studied the so-called "balanced rate criterion", in order to select a point of the achievable-rate region which guarantees fairness among all the active users. We proposed simplified algorithms to calculate an approximate balanced rate solution for the OFDMA case. The loss of the OFDMA solution with respect to the MC-DS-CDMA solution is shown to be acceptable [68].

Analysis of Broadcast Channel and Multiple Access Channel for Slowly Varying Channels We have been the first to design space-time codes for the multiple access channel with non cooperative transmitters and no channel side information at the transmitters. These codes have been found, first for single antennas transmitters [53], and then they have been generalized to the case of multiple antenna transmitters [55]. These codes have been shown to achieve between 6-9 dBs gain compared to time sharing. There are based on number fields and show a non zero minimum determinant when considering all users in error. Finally, the Multiple Access codes have been extended to the case of the Multiple Access Relay Channel (**MARC**) [54].

1.2.4 Statistics for Communications

Faculty P. Ciblat, W. Hachem, A. Tchamkerten

Main events Organisation of NEWCOM Autumn School on "Estimation Theory for Wireless Communications" which took place in Paris in 2005 with 85 attendees. Walid Hachem and Philippe Ciblat have been Associate Editor for IEEE Transactions on Signal Processing since 2007 and 2008 respectively.

Projects ANR DEMAIN, CNRS/ACI MALCOM, CIFRE THALES, ANR SESAME, Royal Society fellowship

Optimal Training for Channel and Frequency Offset Estimation In the context of digital communications, in order to estimate the channel impulse response and also the Carrier Frequency Offset (CFO), a training sequence is sent periodically by the transmitter to the receiver. Of interest is the statistical description of the best training sequence and this can be done by minimizing the Cramer-Rao Bound (CRB). In this situation, most existing works proposed to average the CRB associated with the CFO over the channel statistics. But these works assumed that the channel components are independent and identical distributed (iid), which is a rather restrictive assumption. With this assumption, they established that the best training sequence is the pseudo-random white sequence. But, in practice, the iid hypothesis is often restrictive. We first

revisited the problem of training design for CFO estimation (considering correlated channel components) in the context of OFDM systems. In this situation, we unveiled the trade-offs that govern the optimum training sequence design, and showed that there exist training power profiles which are better than the uniform profile [17, 39]. We then addressed the more difficult problem of designing training sequence for joint estimation of the channel and the carrier frequency offsetjoint but in a single-carrier setting. Since in general the training sequence optimizing CFO estimation is not optimum for channel estimation, we have designed the training sequence that minimizes the Mean-Square Error on the soft estimates of the data symbols obtained using a Wiener equalizer after CFO compensation and averaged over channel statistics. We thus found an "optimal" training sequence, relevant for channel estimation and CFO estimation. Correlated and/or Ricean channel taps have been considered. We showed an significant gain on Bit Error Rate when using the proposed training scheme in lieu of white training [10].

System Recognition for Cognitive Radio In the context of cognitive/opportunistic radio, the signal central frequency does not characterize the used system any more since a system may choose its band in an opportunistic manner. In order to reduce latency, only short signal record has to be considered which may be unfortunately preamble-free. Therefore it is a crucial task to distinguish blindly various OFDM based systems (e.g., Wifi, Wimax, 3GPP/LTE, DVB-T) from each others. We have proposed two main approaches to fix the above-mentioned problem.

First of all, recognition algorithms can be based on the subcarrier spacing value, a quantity which is in general specific to a given OFDM system. Standard approaches rely on the detection of the cyclic prefix which directly provides subcarrier spacing value. Nevertheless these approaches fail when either the cyclic prefix duration is small or the channel impulse response is almost as large as the cyclic prefix. We have thus proposed four new subcarrier spacing estimation algorithms robust to short cyclic prefix and multipath channel [63, 61, 60, 62]. Secondly, we have presented two new OFDM system identification methods based on the structure (not the deterministic value) of the pilot tones. The first proposed scheme relies on the cyclostationarity property induced by the existing structure in time/frequency of the pilot tones. The second one is based on the characteristic of various maximum length sequences used to generate the pilot tones [129, 130].

Channel Estimation Performance for UWB Based Systems In the context of impulse radio UWB, we have addressed the CRB calculation for channel parameter estimation. We have considered a time-hopping code scheme with binary pulse position or pulse amplitude modulation formats. We derived in closed-form the (resp. modified) Cramer-Rao bound for the multipath channel parameters in the data-aided (resp. non-data-aided) context. Unlike existing methods, the calculations have been derived by taking into account the overlapping between signal echoes due to multipath. We showed that it is important to consider the overlapping assumption on realistic channel propagation environment since the Cramer-Rao bound using the non-overlapping assumption clearly overestimated the performance [11].

Tracking Stopping Times Through Noisy Observations Here we investigated a decision problem, the tracking stopping time (TST) problem, whose range of applications spans communication, detection, forecasting, quality control, and finance. The problem is stated as follows. Consider a sequence (X_i, Y_i) of pairs of random variables. At time i Alice observes X_i and Bob observes Y_i only. At a certain time that depends on her previously observed symbols, Alice makes a decision. The goal of Bob is to estimate at best Alice's decision time based only on his observations. In spite of the simplicity of its statement, the TST problem admits no general solutions. In collaboration with Marat Burnashev from the Russian Academy of Sciences in Moscow, we investigate decision time estimates that are provably close to optimal when the X and the Y sequences are highly correlated Brownian motions. Recent related results can be found in [35] and [106].

Large Random Matrix Theory and Wireless Communications The study of the spectral behavior of random matrices when both matrix dimensions converge to infinity at the same pace leads to a deeper understanding of the performance of MIMO systems, multi user receivers, and wireless radio networks. In this context, we studied the distribution of the eigenvalues of a class of large matrices with non centered and correlated entries, and based on this study we characterized the Shannon mutual information of a general class of Ricean correlated MIMO channels [19]. We also proposed an optimization technique for the transmitter covariance matrix in order to attain these channels Shannon's capacity [76]. We also studied the convergence behavior of the $\log\det$ functional (Shannon's mutual information of MIMO channels) [20, 21], as well as the Signal to Noise Ratio at the output of multi user receivers [26], mostly under the form of Central Limit Theorems. These theorems lead to pertinent outage probability approximations.

Performance Detection for Wireless Sensor Networks In the context of wireless randomly located sensor networks intended to detect a 1D or 2D signal (temperature, moisture, ...) often the detection error probability decreases exponentially in the number of sensors. The characterization of the error exponent leads to interesting guidelines as regards the optimum sensor distribution given a correlation structure of the field to be detected. Beginning with the 1D case (detecting a signal by performing a random sampling) we characterized these exponents when the continuous parameter signal is described by a class of scalar or vector stochastic differential equations. We are currently seeking to generalize these findings to the 2D case (detection of a random field).

1.3 References

1.3.1 ACL: Articles in ISI-Indexed Journals

[1] C. Abou Rjeily and J.-C. Belfiore. A Space-Time Coded MIMO TH-UWB Transceiver with Binary Pulse Position Modulation. *IEEE Communications letters*, 11(6):522–524, June 2007.

[2] C. Abou Rjeily, N. Daniele, and J.-C. Belfiore. Distributed algebraic space time codes for ultra wideband communications. *Kluwer special issue on cooperation in wireless networks*, Nov. 2006.

[3] C. Abou Rjeily, N. Daniele, and J.-C. Belfiore. A 2x2 antennas Ultra-Wideband system with biorthogonal pulse position modulation. *IEEE Communications Letters*, 10(5):366–368, May 2006.

[4] C. Abou Rjeily, N. Daniele, and J.-C. Belfiore. Space-time coding for multiuser Ultra-Wideband communications. *IEEE Transactions on Communications*, 54(11):1960–1972, Nov. 2006.

[5] C. Abou Rjeily, N. Daniele, and J.-C. Belfiore. On Space-Time coding with pulse position and amplitude modulations for time-hopping ultra-wideband systems. *IEEE Transactions on Information Theory*, 53(7):2490–2509, July 2007.

[6] C. Abou Rjeily, N. Daniele, and J.-C. Belfiore. On the amplify-and-forward cooperative diversity with time-hopping ultra-wideband communications. *IEEE Transactions on Communications*, 56(4):1–12, Apr. 2008.

[7] J.-C. Belfiore, G. Rekaya, and E. Viterbo. The golden code: a 2x2 full-rate space-time code with nonvanishing determinants. *IEEE Transactions on Information Theory*, 51(4):1432–1436, Apr. 2005.

[8] P. Ciblat and M. Ghogho. Blind NLLS carrier frequency-offset estimation for QAM, PSK, and PAM modulations : performance at low SNR. *IEEE Transactions on Communications*, 54(10):1725–1730, Oct. 2006.

[9] P. Ciblat, M. Ghogho, P. Larzabal, and P. Forster. Harmonic retrieval in the presence of non-circular gaussian multiplicative noise : Performance bounds. *Signal Processing (EURASIP)*, 85(4):737–749, Apr. 2005.

[10] P. Ciblat, P. Bianchi, and M. Ghogho. Training sequence optimization for joint channel and frequency offset estimation. *IEEE Transactions on Signal Processing*, 56(8):3424–3436, Aug. 2008.

[11] P. Ciblat, A.-L. Deleuze, and C. Le Martret. Cramer-Rao bound for Channel Estimation in UWB Impulse Radio. *EURASIP Signal Processing*, 88(4):924–933, Apr. 2008.

[12] J. Dumont, S. Lasaulce, W. Hachem, P. Loubaton, and J. Najim. On the capacity achieving covariance matrix for rician MIMO channels: An asymptotic approach. *IEEE Transactions on Information Theory*, (submitted), Nov. 2007.

[13] G. Feideropoulou, M. Trocan, J. E. Fowler, B. Pesquet-Popescu, and J.-C. Belfiore. Joint source-channel coding with partially coded index assignment for robust scalable video. *IEEE Signal Processing Letters*, 13(4):201–204, Apr. 2006.

[14] G. Feideropoulou, M. Trocan, J. E. Fowler, B. Pesquet-Popescu, and J.-C. Belfiore. Rotated constellations for video transmission over rayleigh fading channels. *IEEE Signal Processing Letters*, 14(9):629–632, Sept. 2007.

[15] S. Gault, W. Hachem, and P. Ciblat. Joint sampling clock offset and channel estimation for OFDM signals : Cramer-rao bound and algorithms. *IEEE Transactions on Signal Processing*, 54(5):1875–1885, May 2006.

[16] S. Gault, W. Hachem, and P. Ciblat. Performance of OFDMA on rayleigh fading channels in a multi-cell environment. *IEEE Transactions on Communications*, 55(4):740–751, Apr. 2007.

[17] M. Ghogho, P. Ciblat, A. Swami, and P. Bianchi. Training Design for Repetitive-Slot-based CFO estimation in OFDM. *IEEE Transactions on Signal Processing*, 2009. To appear.
[18] N. Gresset, J. J. Boutros, and L. Brunel. Multidimensional mappings for iteratively decoded BICM on multiple-antenna channels. *IEEE Transactions on Information Theory*, 51(9):3337–3346, Sept. 2005.
[19] W. Hachem, P. Loubaton, and J. Najim. Deterministic equivalents for certain functionals of large random matrices. *Annals of Applied Probability*, 17(3), 2007.
[20] W. Hachem, O. Khorunzhiy, P. Loubaton, J. Najim, and L. Pastur. A new approach for capacity analysis of large dimensional multi-antenna channels. *IEEE Transactions on Information Theory*, 54(9):3987–4004, Sept. 2008.
[21] W. Hachem, P. Loubaton, and J. Najim. A CLT for information theoretic statistics of gram random matrices with a given variance profile. *Annals of Applied Probability*, 18(6):2071–2130, 2008.
[22] W. Hachem, P. Bianchi, and P. Ciblat. Outage probability based power and time optimization for relay networks. *IEEE Transactions on Signal Processing*, 57(2):764–782, Feb. 2009.
[23] Y. Hong, E. Viterbo, and J.-C. Belfiore. Golden Space-Time trellis coded modulation. *IEEE Transactions on Information Theory*, 53(5):1689–1705, May 2007.
[24] C. Hucher, G. Rekaya-Ben Othman, and J.-C. Belfiore. How to solve the problem of bad performance of cooperative protocols at low SNR? *EURASIP Journal on Advances in Signal Processing.*, 2008, Jan. 2008.
[25] E. Jandot Dit Danjou and J.-C. Belfiore. A 2/spl times/2 antennas bluetooth system. *IEEE Communications Letters*, 9(9):784–786, Sept. 2005.
[26] A. Kammoun, M. Kharouf, W. Hachem, and J. Najim. BER and outage probability approximations for LMMSE detectors on correlated MIMO channels. *IEEE Transactions on Information Theory, accepted for publication*, 2008.
[27] I. Kammoun, A. M. Cipriano, and J.-C. Belfiore. Non coherent codes over the grassmannian. *IEEE Transactions on Wireless Communications*, 6(10):3657–3667, Oct. 2007.
[28] M. A. Khalighi and J. Boutros. Data-aided channel estimation for turbo PIC-MIMO detectors. *IEEE Communications Letters*, 2006.
[29] I. Krikidis and J.-C. Belfiore. Three scheduling schemes for amplify-and-forward relay environments. *IEEE Communications letters*, 11(5):414–416, May 2007.
[30] I. Krikidis and J.-C. Belfiore. Scheduling for amplify-and-forward cooperative networks. *IEEE Transactions on Vehicular Technology*, 56(6):3780–3790, Nov. 2007.
[31] C. Le Martret, A.-L. Deleuze, and P. Ciblat. Optimal time-hopping codes for multi-user interference mitigation in Ultra-Wide Bandwidth impulse radio. *IEEE Transactions on Wireless Communications*, 5(6):1516–1525, June 2006.
[32] A. Le Poupon and O. Rioul. An optimal algorithm for resource allocation with concave objective functions. *RAIRO Operations Research, EDP Sciences*, June 2007.
[33] L. Luzzi, G. Rekaya-Ben Othman, J.-C. Belfiore, and E. Viterbo. Golden space-time block coded modulation. *IEEE Transactions on Information Theory*, 55(2):584–595, Feb. 2009.
[34] B. Mouhouche, P. Loubaton, and W. Hachem. Asymptotic analysis of reduced-rank chip-level MMSE equalizers in the downlink of CDMA systems. *IEEE Transactions on Signal Processing*, 55(6):3048–3060, June 2007.
[35] U. Niesen and A. Tchamkerten. Tracking stopping times through noisy observations. *IEEE Transactions on Information Theory*, 55(1):422–432, Jan. 2009.
[36] F. Oggier, G. Rekaya, J.-C. Belfiore, and E. Viterbo. Perfect space time block codes. *IEEE Transactions on Information Theory*, 52(9):3885– 3902, Sept. 2006.
[37] M. Pischella and J.-C. Belfiore. Distributed resource allocation for rate-constrained users in multi-cell ofdma networks. *IEEE Communications Letters*, 12(4):250–252, Apr. 2008.
[38] M. Pischella and J.-C. Belfiore. Power Control in Distributed Cooperative OFDMA Cellular Networks. *IEEE Transactions on Wireless Communications*, June 2008.
[39] S. Sezginer, P. Bianchi, and W. Hachem. Asymptotic Cramér-Rao bounds and training design for MIMO-OFDMA uplink transmissions with frequency offset. *IEEE Transactions on Signal Processing*, 55(7, part II):3606 – 3622, July 2007.
[40] G. Shamir and J. Boutros. Non systematic low-density parity check codes for nonuninform sources. *IEEE International Symposium on Information Theory*, Sept. 2005.
[41] K. Shi, E. Serpedin, and P. Ciblat. Decision-directed fine synchronization in OFDM systems. *IEEE Transactions on Communications*, 53(3):408–412, Mar. 2005.
[42] A. Tchamkerten, V. Chandar, and G. Wornell. Communication under strong asynchronism. *IEEE Transactions on Information Theory*, Apr. 2009.
[43] S. Yang and J.-C. Belfiore. Optimal Space-Time codes for the MIMO Amplify-and-Forward cooperative channel. *IEEE Transactions on Information Theory*, 53(2):647–663, Feb. 2007.
[44] S. Yang and J.-C. Belfiore. Towards the optimal Amplify-and-Forward cooperative diversity scheme. *IEEE Transactions on Information Theory*, 53, Sept. 2007.

1.3.2 INV: Invited Talks

[45] J.-C. Belfiore, M. Badr, S. Yang, and G. Rekaya. DMT achieving distributed space time codes for the multiple access channel,. In *Asilomar Conference on Signals, Systems, and Computers, Invited Talk*, pages 810 – 813, Monterey, CA, Oct. 2007.
[46] S. Yang and J.-C. Belfiore. (Distributed) Space-Time Codes for the MIMO Multihop Channel via Partitions of the Channel. In *IEEE Information Theory workshop, Invited Talk*, Bergen, Norway, July 2007.

1.3.3 ACTI: Articles in Proceedings of International Conferences

[47] R. Abdelfattah, O. Rioul, and P. Duhamel. Linear scalar quantization of wavelet image decomposition using joint optimization. In *12th IEEE Conference on Electronics, Circuits and Systems (ICECS'05)*, Gammarth, Tunisia, Dec. 2005.

[48] C. Abou Rjeily, N. Daniele, and J.-C. Belfiore. A new family of space-time codes for pulse amplitude and position modulated UWB systems. In *2006 IEEE International Symposium on Information Theory*, July 2006.

[49] C. Abou Rjeily, N. Daniele, and J.-C. Belfiore. A new full rate full diversity st code with nonvanishing determinant for th-uwb systems. In *2006 International Zurich Seminar on Communications*, pages 198 – 201, Mar. 2006.

[50] C. Abou Rjeily, N. Daniele, and J.-C. Belfiore. MIMO UWB communications using modified hermite pulses. In *2006 IEEE 17th International Symposium onPersonal, Indoor and Mobile Radio Communications*, Sept. 2006.

[51] C. Abou Rjeily, N. Daniele, and J.-C. Belfiore. Distributed space-time coding with ultra-wideband systems. In *2006 IEEE 17th International Symposium on Personal, Indoor and Mobile Radio Communications*, Sept. 2006.

[52] C. Abou Rjeily, N. Daniele, and J.-C. Belfiore. On the decode-and-forward cooperative diversity with coherent and non coherent UWB systems. In *IEEE International conference on Ultra-wideband*, 2006.

[53] M. Badr and J.-C. Belfiore. Distributed space-time block codes for the non cooperative multiple access channel. In *IEEE International Zurich Seminar on Communications, 2008*, pages 132 – 135, Zürich, Switzerland, Mar. 2008.

[54] M. Badr and J.-C. Belfiore. Distributed space time codes for the amplify-and-forward multiple-access relay channel. In *IEEE International Symposium on Information Theory*, pages 2543 – 2547, Toronto, Canada, July 2008.

[55] M. Badr and J.-C. Belfiore. Distributed space-time block codes for the mimo multiple access channel. In *IEEE International Symposium on Information Theory*, pages 2553 – 2557, Toronto, Canada, July 2008.

[56] M. Badr, E. Calvanese Strinati, and J.-C. Belfiore. Optimal power allocation for hybrid amplify-and-forward cooperative networks. In *IEEE Vehicular Technology Conference, VTC Spring 2008*, pages 2111 – 2115, Singapore, May 2008.

[57] P. Bianchi and P. Ciblat. Training sequence design for joint channel and frequency offset estimation with partial channel state information. In *IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, Helsinki, Finland, June 2007.

[58] P. Bianchi, P. Ciblat, and W. Hachem. Outage performance of a novel relaying protocol: Decode or Quantized and Forward. In *International Symposium on Information Theory and its Applications (ISITA)*, Auckland, New Zealand, Dec. 2008.

[59] J. Boutros, A. Alloum, and G. Shamir. Enhanced channel decoding via em source-channel estimation. In *2nd International Symposium on Communications, Control and Signal Processing*, Marrakech (Maroc), Mar. 2006.

[60] A. Bouzegzi, P. Ciblat, and P. Jallon. Maximum likelihood based method for intercarrier spacing characterization. In *IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC)*, Cannes, France, Sept. 2008.

[61] A. Bouzegzi, P. Ciblat, and P. Jallon. Matched filter based algorithm for blind recognition of OFDM systems. In *IEEE Vehicular Technology Conference (VTC)*, Calgary, Canada, Sept. 2008.

[62] A. Bouzegzi, P. Jallon, and P. Ciblat. A second order statistics based algorithm for blind recognition of OFDM based systems. In *IEEE Global Telecommunications Conference (GLOBECOM)*, New Orleans, USA, Nov. 2008.

[63] A. Bouzegzi, P. Jallon, and P. Ciblat. A fourth-order based algorithm for characterization of OFDM signals. In *IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, Recife, Brazil, July 2008.

[64] E. Calvanese Strinati, S. Yang, and J.-C. Belfiore. Adaptive modulation and coding for hybrid cooperative networks. In *IEEE International Conference on Communications, 2007. ICC '07*, pages 4191 – 4195, June 2007.

[65] D. Champion, J.-C. Belfiore, G. Rekaya, and E. Viterbo. Partitionning the golden code : A framework to the design of space-time coded modulation. In *Canadian Workshop on Information Theory*, Montreal, Canada, June 2005.

[66] P. Ciblat and M. Ghogho. Ziv-zakai bound for harmonic retrieval in multiplicative and additive gaussian noise. In *IEEE Workshop on Statistical Signal Processing (SSP'2005)*, Bordeaux (France), July 2005.

[67] P. Ciblat, P. Bianchi, and M. Ghogho. Optimal training for frequency offset estimation in correlated-rice frequency-selective channel. In *IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, Recife, Brazil, July 2008.

[68] A. Cipriano, P. Ciblat, S. Gault, and W. Hachem. Balanced allocation strategy in multi-user OFDM with channel state information at the transmitter. In *EURASIP European Signal Processing Conference (EUSIPCO)*, Florence, Italy, Sept. 2006.

[69] A. M. Cipriano, I. Kammoun, and J.-C. Belfiore. Simplified decoding for some non-coherent codes over the grassmannian. In *ICC 2005*, volume 2, pages 757–761, Seoul Corée, May 2005.

[70] A.-L. Deleuze, P. Ciblat, and C. Le Martret. Inter-symbol/inter-frame interference in time-hopping ultra wideband impulse radio system. In *IEEE International Conference on Ultra-Wideband (ICU'2005)*, Zürich (Suisse), Sept. 2005.

[71] A.-L. Deleuze, P. Ciblat, and C. Le Martret. Rake receiver improvement for residual interference cancellation in UWB context. In *IEEE Vehicular Technology Conference (VTC)*, Dublin, Irland, Apr. 2007.

[72] B. Denis, M. Pezzin, S. De Rivaz, S. Dubouloz, M. Sambuq, L. Ouvry, and G. Rodriguez. A ldr ir-uwb receiver architecture based on 1-bit direct sampling. In *IST Mobile Summit 2006*, June 2006.

[73] S. Dubouloz, M. Pelissier, B. Denis, M. Sambuq, L. Ouvry, and G. Rodriguez. Energy characteristics of uwb channel models applied to system design. In *IEEE International Conference on Ultra-Wideband*, Sept. 2005.

[74] S. Dubouloz, S. De Rivaz, M. Sambuq, L. Ouvry, and G. Rodriguez. Effects of hard decision on the detection of preambles for uwb non-coherent communications. In *IEEE International Conference on Ultra-Wideband*, 2006.

[75] S. Dubouloz, A. Rabbachin, B. Denis, S. De Rivaz, L. Ouvry, and G. Rodriguez. Performance analysis of low complexity solutions for uwb low data rate impulse radio. In *IEEE International Symposium on Circuits and Systems*

- *ISCAS*, May 2006.

[76] J. Dumont, W. Hachem, S. Lasaulce, P. Loubaton, and J. Najim. High SNR approximations of the capacity of MIMO correlated rician channels: a large system approach. In *ISIT*, June 2007.

[77] S. Gault, W. Hachem, and P. Ciblat. An OFDMA based modem for powerline communications over the low voltage distribution network. In *IEEE International Conference on Powerline Communications and its Applications (ISPLC'2005)*, Vancouver (Canada), Apr. 2005.

[78] S. Gault, W. Hachem, and P. Ciblat. Performance of a resource allocation strategy for an FH-OFDMA based system in a multi-cell environment. In *IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, Cannes, France, July 2006.

[79] M. Ghogho, A. Swami, and P. Ciblat. Training design for CFO estimation in OFDM over correlated multipath fading channels. In *IEEE Global Telecommunications Conference (GLOBECOM)*, Washington, USA, Nov. 2007.

[80] W. Hachem, P. Bianchi, and P. Ciblat. Outage probability based power and time optimization for relay networks. In *IEEE Information Theory Workshop (ITW)*, Porto, Portugal, May 2008.

[81] W. Hachem, P. Loubaton, and J. Najim. On the fluctuations of the mutual information of large dimensional MIMO channels. In *ITW*, Mar. 2008.

[82] W. Hachem, E. Moulines, J. Najim, and F. Roueff. On the error exponents for detecting randomly sampled noisy diffusion processes. In *ICASSP*, Taipei, Taiwan, Apr. 2009.

[83] Y. Hong, E. Viterbo, and J.-C. Belfiore. High rate golden space-time trellis coded modulation. In *Fortieth Asilomar Conference on Signals, Systems and Computers*, pages 2087 – 2091, Oct. 2006.

[84] Y. Hong, E. Viterbo, and J.-C. Belfiore. A space-time block coded multiuser mimo downlink transmission scheme. In *2006 IEEE International Symposium on Information Theory*, July 2006.

[85] Q. Huang, M. Ghogho, J. Wei, and P. Ciblat. Time and frequency synchronization for OFDM based cooperative systems. In *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, Taipei, Taiwan, Apr. 2009.

[86] C. Hucher, G. Rekaya-Ben Othman, and J.-C. Belfiore. Adaptive amplify-and-forward cooperative channel. In *International Symposium on Information Theory*, Nice, France, July 2007.

[87] C. Hucher, G. Rekaya-Ben Othman, and J.-C. Belfiore. AF and DF Protocols based on Alamouti ST Code. In *IEEE International Symposium on Information Theory*, Nice, France, July 2007.

[88] C. Hucher, G. Rekaya-Ben Othman, and A. Saadani. A new partial decode-and-forward protocol. In *IEEE Wireless Communications and Networking Conference*, Las Vegas, USA, Apr. 2008.

[89] C. Hucher, G. Rekaya-Ben Othman, and A. Saadani. New protocols for the cooperative mac. In *Asilomar Conference on Signals, Systems and Computers*, California, USA, Oct. 2008.

[90] A. Kammoun, M. Kharouf, W. Hachem, and J. Najim. Fluctuations of the SNR at the Wiener filter output for large dimensional signals. In *SPAWC*, Recife, Brazil, 2008.

[91] A. Kammoun, M. Kharouf, W. Hachem, and J. Najim. Outage probability approximation for the wiener filter SINR in MIMO systems. In *SPAWC*, Recife, Brazil, 2008.

[92] F. Kharrat-Kammoun, P. Ciblat, and C. Le Martret. Error probability approximation and codes selection in the presence of multi-user interference for IR-UWB. In *IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC)*, Cannes, France, Sept. 2008.

[93] M. Kobayashi, M. Debbah, and J.-C. Belfiore. Outage efficient strategies for network mimo with partial csit. In *2009 IEEE International Symposium on Information Theory*, Seoul, Korea, July 2009.

[94] G. Kraidy, N. Gresset, and J. Boutros. Information theoretical versus algebraic constructions of linear unitary prcoders for non-ergodic multiple antenna channels. In *Canadian Worshop on Information Theory*, Montreal Canada, June 2005.

[95] N. Ksairi, P. Bianchi, P. Ciblat, and W. Hachem. Optimal reuse factor and resource allocation for downlink OFDMA with multicell interference. In *Workshop on Signal Processing Advances for Wireless Communications (SPAWC)*, Recife, Brazil, July 2008.

[96] N. Ksairi, P. Bianchi, W. Hachem, and P. Ciblat. Resource allocation for downlink OFDMA 2D-cellular networks with partial frequency reuse. In *ISITA*, Auckland, New Zealand, 2008.

[97] A. Le Duc, P. Ciblat, and C. Le Martret. Closed-form expressions for Packet Error Rate and Efficiency in cross-layer HARQ schemes. In *IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC)*, Perugia, Italy, June 2009.

[98] A. Le Poupon and O. Rioul. An optimal algorithm for resource allocation with concave cost functions. In *5th ALIO/EURO Conference on Combinatorial Optimization*, Paris, France, Oct. 2005.

[99] L. Luzzi, G. Rekaya-Ben Othman, J.-C. Belfiore, and E. Viterbo. Golden space-time block coded modulation. In *IEEE Workshop on Information Theory (ITW)*, Porto, Portugal, May 2008.

[100] A. Mahmood and J.-C. Belfiore. Improved 3-db subgroup based algorithm for optimal discrete bit-loading. In *2008 IEEE Sarnoff Symposium*, Apr. 2008.

[101] L. Mroueh, S. Rouquette-Léveil, G. Rekaya-Ben Othman, and J.-C. Belfiore. On the performance of the Golden code in BICM-MIMO and IEEE 802.11n cases. In *Asilomar Conference on Signals, Systems and Computers*, California, USA, Nov. 2007.

[102] L. Mroueh, M. O. Damen, S. Rouquette-Léveil, G. Rekaya-Ben Othman, and J.-C. Belfiore. Code construction for the selective tdma cooperative broadcast channel. In *IEEE International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC)*, Cannes, France, Sept. 2008.

[103] L. Mroueh, S. Rouquette-Léveil, G. Rekaya-Ben Othman, and J.-C. Belfiore. Dmt of weighted parallel channels : Application to broadcast channels. In *IEEE International Symposium on Information Theory (ISIT)*,, Toronto, Canada, July 2008.

[104] L. Mroueh, S. Rouquette-Léveil, G. Rekaya-Ben Othman, and J.-C. Belfiore. Dmt achieving schemes for the isotropic fading vector broadcast channel. In *IEEE International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC)*, Cannes, France, Sept. 2008.
[105] M. Nahas, A. Saadani, and W. Hachem. On the outage probability of asynchronous wireless cooperative networks. In *VTC Fall*, 2008.
[106] U. Niesen and A. Tchamkerten. Detection of a stopping time through noisy observations. In *International Workshop on Sequential Methodologies*, June 2009.
[107] F. Oggier, P. Solé, and J.-C. Belfiore. Codes over m_2(f_2) and applications to golden space-time coded modulation. In *IEEE International Symposium on Information Theory*, Seoul, Korea, July 2009.
[108] R. Ouertani, A. Saadani, G. Rekaya-Ben Othman, and J.-C. Belfiore. On the Golden code performance for MIMO-HSDPA systems. In *IEEE Vehicular Technology Conference*, Montreal, Canada, Sept. 2006.
[109] R. Ouertani, G. Rekaya-Ben Othman, and A. Salah. The spherical bound stack decoder. In *IEEE International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob)*, Avignon, France, Oct. 2008.
[110] R. Ouertani, G. Rekaya-Ben Othman, and J.-C. Belfiore. An adaptive mimo decoder. In *Vehicular Technology Conference (VTC)*, Barcelone, Espagne, Apr. 2009.
[111] M. Pischella and J.-C. Belfiore. Optimal power allocation for downlink cooperative cellular networks. In *VTC-Spring*, 2007.
[112] M. Pischella and J.-C. Belfiore. Distributed weighted sum throughput maximization in multi-cell wireless networks. In *IEEE 19th International Symposium on Personal, Indoor and Mobile Radio Communications, 2008*, Cannes, France, Sept. 2008.
[113] M. Pischella and J.-C. Belfiore. Distributed weighted sum throughput maximization in multi-cell wireless networks. In *International Workshop on Cross-Layer Design*, Palma de Mallorca Spain, June 2009.
[114] M. Pischella and J.-C. Belfiore. Distributed resource allocation in mimo ofdma networks with statistical csit. In *IEEE International Workshop on Signal Processing Advances in Wireless Communications*, Perugia, Italy, June 2009.
[115] M. Pischella and J.-C. Belfiore. Optimal power allocation for downlink cooperative cellular networks. In *IEEE 65th Vehicular Technology Conference, 2007. VTC2007-Spring*, pages 2864 – 2868, Apr. 2007.
[116] M. Pischella and J.-C. Belfiore. Qos-based resource allocation with cooperative diversity in ofdma. In *IEEE Vehicular Technology Conference, VTC Spring 2008*, pages 1896 – 1900, Singapore, May 2008.
[117] M. Pischella and J.-C. Belfiore. Achieving a frequency reuse factor of 1 in ofdma cellular networks with cooperative communications. In *IEEE Vehicular Technology Conference, VTC Spring 2008*, pages 653 – 657, Singapore, May 2008.
[118] A. Ray, K. Vinodh, G. Rekaya-Ben Othman, and V. Kumar. Ideal structure of the silver code. In *IEEE International Symposium on Information Theory (ISIT)*, Seoul, Corée, June 2009.
[119] G. Rekaya, J.-C. Belfiore, and E. Viterbo. Rectangular algebraic space-time block codes. In *Canadian Workshop on Information Theory*, Montreal, Canada, June 2005.
[120] G. Rekaya-Ben Othman, L. Luzzi, and J.-C. Belfiore. Algebraic reduction for the golden code. In *IEEE International Conference on Communications (ICC)*, Dresden, Allemagne, June 2009.
[121] O. Rioul. A simple proof of the entropy-power inequality via properties of mutual information. In *IEEE International Symposium on Information Theory (ISIT 2007)*, pages 46–50, Nice, France, June 2007.
[122] A. Salah, A. Saadani, and G. Rekaya-Ben Othman. On the linear precoding of non-orthogonal STBC for MIMO systems. In *IEEE International Symposium on Personal Indoor and Mobile Radio Communications*, Athens, Greece, Sept. 2007.
[123] A. Salah, G. Rekaya-Ben Othman, R. Ouertani, and S. Guillouard. New soft stack decoder for mimo channel. In *Asilomar Conference on Signals, Systems and Computers*, California, USA, Oct. 2008.
[124] A. Salah, G. Rekaya-Ben Othman, and S. Guillouard. Parallel stack decoding for mimo schemes. In *IEEE Vehicular Technology Conference (VTC)*, Barcelone, Espagne, Apr. 2009.
[125] M. Sarkiss, J.-C. Belfiore, and Y. Yuan. Performance comparison of different golden code detectors. In *IEEE 18th International Symposium on Personal, Indoor and Mobile Radio Communications, 2007. PIMRC 2007*, Sept. 2007.
[126] M. Sarkiss, M. O. Damen, and J.-C. Belfiore. 2×2 delay-tolerant distributed space-time codes with non-vanishing determinants. In *IEEE 19th International Symposium on Personal, Indoor and Mobile Radio Communications, 2008*, Cannes, France, Sept. 2008.
[127] M. Sarkiss, G. Rekaya-Ben Othman, and J.-C. Belfiore. 4x4 perfect space-time code partition. In *Asilomar Conference on Signals, Systems and Computers*, California, USA, Oct. 2008.
[128] G. Shamir, L. Wang, and J. Boutros. High rate non systematic ldpc codes for nonuniform sources. In *4th International Symposium on Turbo Codes and Related Topics*, Munich, Allemagne, Apr. 2006.
[129] F.-X. Socheleau, S. Houcke, A. Aissa El Bey, and P. Ciblat. OFDM system identification based on m-sequence signature in cognitive radio context. In *IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC)*, Cannes, France, Sept. 2008.
[130] F.-X. Socheleau, P. Ciblat, and S. Houcke. OFDM system identification for cognitive radio based on pilot-induced cyclostationarity. In *IEEE Wireless Communications and Networking Conference (WCNC)*, Budapest, Hungary, Apr. 2009.
[131] A. Tchamkerten and G. Avoine. An efficient distance bounding rfid authentication protocol: Balancing false-acceptance rate and memory requirement. In *Information Security Conference*, Pisa, Italie, June 2009.
[132] S. Yang and J.-C. Belfiore. The impact of channel estimation error on the DPC region of the two-user gaussian broadcast channel. In *43rd Allerton Conference*, Allerton (IL) USA, Sept. 2005.
[133] S. Yang and J.-C. Belfiore. Optimal space-time codes for the amplify-and-forward cooperative channel. In *43rd*

Allerton Conference, Allerton (IL) USA, Sept. 2005.
[134] S. Yang and J.-C. Belfiore. A novel two-relay three-slot amplify-and-forward cooperative scheme. In *40th Annual Conference on Information Sciences and Systems*, pages 1329 – 1334, Mar. 2006.
[135] S. Yang and J.-C. Belfiore. On slotted amplify-and-forward cooperative diversity schemes. In *2006 IEEE International Symposium on Information Theory,*, pages 2446 – 2450, July 2006.
[136] S. Yang and J.-C. Belfiore. On the diversity of rayleigh product channels. In *IEEE International Symposium on Information Theory, 2007. ISIT 2007*, pages 1276 – 1280, Nice, France, June 2007.
[137] S. Yang and J.-C. Belfiore. Optimal space-time codes for the mimo amplify-and-forward cooperative channel. In *2006 International Zurich Seminar on Communications*, pages 122 – 125, Mar. 2006.
[138] S. Yang, J.-C. Belfiore, and G. Rekaya-Ben Othman. Perfect Space-Time Block codes for parallel MIMO channels. In *IEEE International Symposium on Information Theory*, Seatle, USA, Sept. 2006.
[139] Z. Zhipeng and J.-C. Belfiore. Application of cooperative diversity in 802.11a ad-hoc networks. In *Proceedings of 16th International Conference onComputer Communications and Networks, 2007. ICCCN 2007*, pages 1016 – 1021, Aug. 2007.

1.3.4 ACTN: Articles in Proceedings of French Conferences

[140] P. Ciblat and P. Bianchi. Séquence d'apprentissage optimale pour l'estimation conjointe du canal et du résidu de fréquence. In *GRETSI*, Troyes, France, Sept. 2007.
[141] P. Ciblat and M. Ghogho. Probabilité de décrochement d'un estimateur autodidacte du résidu de porteuse. In *GRETSI*, Louvain-la-Neuve (Belgique), Sept. 2005.
[142] J. Dumont, W. Hachem, S. Lasaulce, P. Loubaton, and J. Najim. Quelques propriétés d'un approximant de l'information mutuelle des canaux MIMO de rice bi-corrélés. In *GRETSI*, Sept. 2007.
[143] W. Hachem, P. Loubaton, and J. Najim. Sur les fluctuations de l'information mutuelle des canaux MIMO de grandes dimensions. In *GRETSI*, Sept. 2007.
[144] A. Le Duc, C. Le Martret, P. Ciblat, and H. Labiod. Procédé de retransmission à redondance incrémentale adapté aux paquets IP fragmentés. In *GRETSI*, Troyes, France, Sept. 2007.

1.3.5 COM: Talks in Conferences Which Do Not Publish Proceedings

[145] J. Boutros. A tutorial on iterative probabilistic decoding and channel estimation. In *IAP Motion plenary meeting, Ghent university*, Ghent Belgium, June 2005.
[146] G. Shamir, J. Boutros, A. Alloum, and L. Wang. Non-systematic ldpc codes for redundant data. In *Inaugural Worshop for the Center of Information Theory and its applications, UCSD , and the Jacobs School of Engineering*, San Diego, California, Feb. 2006.

1.3.6 OS: Books and Book Chapters

[147] J.-C. Belfiore and A. M. Cipriano. Space-Time coding for non coherent channels. In H. Boelcskei, D. Gesbert, C. Papadias, and A. J. van der Veen, editors, *Space-Time Wireless Systems: From Array Processing to MIMO Communications*, chapter 10. Cambridge University Press, 2005.
[148] F. Oggier, J.-C. Belfiore, and E. Viterbo. *Cyclic Division Algebra: A tool for Space-Time Coding*. Foundations and Trends in Communications and Information theory, NowPublishers, Boston, MA (USA), 2007.
[149] O. Rioul. *Théorie de l'Information et du Codage*. Hermes Science - Lavoisier, Paris, 2007.

1.3.7 AP: Other Productions: Database, Registred Software, Registred Patent, . . .

[150] A. Bouzegzi, P. Jallon, and P. Ciblat. Méthode d'estimation aveugle de paramètres de modulation OFDM. (DD10194), 2008.
[151] A. Bouzegzi, P. Jallon, and P. Ciblat. Méthode d'estimation aveugle de paramètres de modulation OFDM selon un critère de maximum de vraisemblance. (DD10949), 2008.
[152] A. Bouzegzi, P. Jallon, and P. Ciblat. Méthode d'estimation aveugle de paramètres de signal OFDM par filtrage adapté. (DD10950), 2008.
[153] A. Bouzegzi, P. Jallon, and P. Ciblat. Méthode de détection et d'identification aveugle des signaux ofdm par recherches successives. (DD11099ST), Feb. 2009.
[154] P. Ciblat. Synchronisation et Allocation des ressources en télécommunications sans fil, HDR. Technical report, Université de Marne-la-Vallée, July 2007.
[155] A.-L. Deleuze, C. Le Martret, and P. Ciblat. Communication à accès multiple basée sur une couche physique ultra-large bande par impulsion. (WO/2007/090851), Feb. 2007.
[156] C. Hucher, G. Rekaya-Ben Othman, and A. Saadani. Codage spatio-temporel pour système coopératif. (0757576), Sept. 2007.

[157] G. Rekaya-Ben Othman, L. Luzzi, and J.-C. Belfiore. Procédé de décodage dun signal ayant subi un codage espace/temps avant émission, dans un système multi-antennaires, produit programme dordinateur et dispositif de décodage correspondant. (FR 08/55882), Sept. 2008.

[158] G. Rekaya-Ben Othman, R. Ouertani, and J.-C. Belfiore. Procédé de décodage d'un signal transmis dans un système multi-antennes, produit programme d'ordinateur et dispositif de décodage correspondants. (08/50690), Feb. 2008.

[159] G. Rekaya-Ben Othman, A. Salah, and S. Guillouard. Procédé de décodage d'un signal mettant en oeuvre une construction progressive d'un arbre de décodage, produit programme d'ordinateur et signal correspondants. (0852985), May 2008.

Chapter 2

Complex Digital Electronic Systems (SEN)

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Faculty

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Sabbaticals

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Faculty [IT, CNRS]	[8.5 , 2]
PhD students	8
Post-docs, engineers and sabbaticals	5.5
Defended PhD theses	7
Defended HDR	1
Journal papers [published, in press]	[17, 2]
Papers in conference proceedings	86
Chapters and books	3
Patents and software	[9, 4]
Grants [public, private, european] (k€)	[2747, 458, 164]

2.1 Objectives

The "Complex Digital Electronic System" team research topics are oriented towards efficient design of digital electronic systems. The team's research is based on the development of new algorithms, new architectures and new methods taking into account recent and future integrated technologies evolutions. The objectives are closely linked to the study of cutting edge techniques which allows electronic designers to meet ever growing constraints like complexity management, reliability, consumption, speed, and flexibility. Application focus on wireless digital communications, multimedia processing and security (trusted computing hardware).

The team has regular research collaborations with well known companies of the area such has STMicroelectronics, NXP, Freescale, ST-Ericsson, CEA, Orange or TexasInstruments. Among the academic laboratories the most representative are the CNRS laboratories LIP6 (UMR7606), LIRMM (UMR5506), GIPSA-Lab (UMR5216) or TIMA (UMR51599). We are also highly involved in the CIM (Centre Intégré de Microélectronique) PACA regional framework and the SAME (Sophia Antipolis MicroElectronics) association, two very important academic-industrials French consortiums. In order to balance industrials concerns and advanced academic research, we increased during the two past years our effort for PhD supervision. We focused our research towards four main themes. Design methodologies are coverered by the **Design Space exploration and assisted refinement of integrated systems** theme. Architectures interaction whith technologies are covered by the **Optimal architectures for complex algorithms implementations** theme, with a recent growing activity on reliability. Specific architectures for wireless digital communication are handled by the **Software defined radio** theme with internal collaboration with other teams of Telecom-ParisTech. The **Trusted computed hardware** theme, aiming at protection of hardware for security, has started seven years ago. It has now reached a mature status, with national and international recognition, as stated by the sabbatical of Pr Homma (Tohoku University), and the association of industrial researcher H. Chabanne from Sagem.

Team members, located in the sites of Paris and Sophia-Antipolis (LabSoC), have a strong teaching activity in the undergraduate and Master level at Telecom–ParisTech. Lectures are in the fields of digital electronic design, embedded systems design, SoC (Systems–on–Chip) design and embedded systems security. An important part is given to practical aspects which are covered by supervisions of numerous student projects. The latest research results feeds our teaching activity, for example, ANR SoCLib project methods are directly used in the "System-On-Chip Design" track of our Master of engineering. Team members have teaching activities and responsabilities at Master level in several others institutions such as Eurecom, Nice Sophia-Antipolis University or Paris-6 University.

2.2 Main Results

The main research results obtained during the period 2005-2009 are presented below for the research areas of the Complex Digital Electronic System team.

2.2.1 Design Space Exploration and Assisted Refinement of Integrated Systems

Faculty L. Apvrille, R. Pacalet, S. Coudert, R. Boulifa

Main events Release of the TTool[1] Open Source toolkit, creation and animation of the SAFA (Sophia-Antipolis Formal Analysis Group) workshop.

Projects Industrial contracts with Texas Instruments (CASA I to V) and UDcast, Cifre PhD with Freescale, FP7 european project EVITA.

The increasing complexity of Systems-on-Chip requires new design and verification methodologies. The approach developed at LabSoC relies on modeling at a very high level and on early verifications in the design cycle. A strong separation between control and data processing is introduced. At the highest levels data processing is completely abstracted away. Control–oriented tasks exchange abstract and valueless samples, allowing ultra-fast simulations and static formal verification. This approach is supported by a dedicated UML profile (DIPLODOCUS) and a software toolkit (TTool). For the period 2005–2009 the main achievements are:

System-level Design Space Exploration (DSE): definition of a three-step methodology, comprising application modeling, architecture modeling and mapping of the former on the latter [228]. Simulation and formal verification are used in the first and second steps [194]. THe current focus is on the post-mapping verification.

Fast simulation techniques: design and SystemC-Based implementation if a speculative, transaction-based simulaiton framework [232].The current focus is on concurrent exploration of different simulation traces.

Formal verification: formal definition of the sets of primitives used in application and architecture modelling. Formal description of the mapping phase [194]. To overcome limitations of reachability analysis (e.g. combinatorial explosion, lack of refinement techniques), an formal verification scheme based on Description Logics has been investigated [195].

The TTool toolkit: design and open–source release of a toolkit. This toolkit shares several features with related works of the team, on distributed systems [161] [160] and requirement capture [194]. TTool is supported by Freescale. The whole framework is currently used in the context of the European project EVITA for security modelling and analysis ou automotive security.

IP abstraction: proposal of abstraction techniques of fully detailed existing virtual components to allow high level verification. IPs at Register Transfert Level are raised at Bus Cycle Accurate Level [286] for verification. Data values are abstracted and replaced by data “presence” and dependency calculus replaces value computation. We then verify by model checking that outputs are produced at the expected dates with respect to the arrival dates of the corresponding inputs. This data dependency analysis also leads to control and data separation: [248] control or data labels are propagated from the primary inputs to the primary outputs and the module is sliced in two disjoined regions, allowing data abstraction and fast verification of the control slice. This work is theoretically founded. It relies on a rigorous approach of semantic data dependency at propositional logic level (and thus gate level). Approximations and complementary techniques (such as data bundling) are introduced to mitigate the complexity through accuracy-runtime tradeoffs. This work also impacts our research activity on security.

[1] http://labsoc.comelec.enst.fr/turtle/ttool.html

2.2.2 Trusted Computing Hardware

Faculty J-L Danger, T. Graba, S. Guilley, P. Hoogvorst, Y. Mathieu, R. Pacalet

Main events DPA Contest organisation at CHES'09.

Projects ACI MARS, ANR SAFE, ANR SeFPGA, ANR ICTER, System@tic Pôle "Secure Algorithm", TES Pôle "EPOMI" STMicroelectronics "PACA Lab" projects SecMat, SecBus, SecKer, CALMOS, Cifre PhD with STMicroelectronics.

Cryptoprocessor implementations can be attacked by taking advantage of physical emanations when the ciphering operations are executed or by injecting faults to modify its behaviour. The attack goal is to recover the secret key of the known algorithm, or to modify the code stored in external memories. The research challenge is to provide countermeasures able to thwart all kind of attacks. The passive attacks also called "Side Channel Attacks" are based on the analyzis of the physical activity which can be made either by observing the power lines or the electromagnetic field radiation. The active attacks consist in injecting faults. They can be generated by methods like underpowering the power supply, parasitic glitches emissions or laser shots. The attacks and therefore their protections are done at circuit level or board level. At circuit level they aim at recovering the ciphering key or even the algorithm. They can be performed on any circuit from the smartcard to the big VLSI devices.
Board-level probing attacks use external memories and memory buses as natural targets. Adversaries can acquire confidential data and even corrupt the execution of critical programs by much simpler means than what is required for silicon-level attacks.

Protection at logical and physical level: These protections have been carried out on customized prototypes ASIC circuits and FPGAs in order to understand the attack mechanisms and devise efficient countermeasures. Four ASIC chips have been designed in 130nm STM technology. They embed a complete System–on–Chip including cryptoprocessors implementing DES and AES algorithms with different level of protections. Passive attacks [220] and active attacks [253] have been performed successfully on unprotected cryptoprocessors [165]. New attacks have been devised. Some of them take advantage of the Electromagnetic acquisition [177]. Countermeasures based on differential logic [278] have been evaluated and their efficiency has been demonstrated [164, 166]. Protections against attacks have been carried out on both embedded and commercial FPGAs. A custom fully reconfigurable embedded FPGA has been designed [205] to allow dynamic reconfiguration of the cryptoprocessor in case of attacks [206]. Asynchronous logic in a custom FPGA has been investigated as a countermeasure against passive attacks. The architecture has been studied at both the interconnexion level [209] and the programmable cell [263]. A versatile cell with multi-style capability has been studied in order to increase the robustness [199]. Many protections have been devised and evaluated in commercial FPGAs. They are based either on "Hiding" techniques [224, 221] by using differential Logic or "masking" techniques [226] by using a random variable. Their complexity and computation performances have been optimized [225]. Innovative structures to protect cryptoprocessors have been patented [276, 275, 279, 274]. Fault attacks have been studied by simple and efficient methods like underpowering the power supply on an AES cryptoprocessor [231]. The random number generation which is critical to obtain a good entropy has been studied with a high speed constraint. A novel open loop TRNG structure based on a latch chain has been devised and tested [162].

Protection at board level: In close partnership with the Advanced Systems Technology division of STMicroelectronics[2] we are working on a secure architecture [255] dedicated to medium to low end embedded systems and without any modification of the CPU nor the software design tools (which is considered unrealistic in this market). A strong cooperation between a trusted micro-kernel or hypervisor and a cryptographic peripheral (nicknamed SecBus) allows us to apply cryptographic functions only when needed and to select the less expensive among a set of candidate primitives for a given context. Our recent performance evaluations show that the SecBus

[2] Industrial contract PACA Lab 2004-2009, Cifre PhD of Lifeng SU

architecture is a very promising and cost effective solution to guarantee the nominal utilization of consumer equipments, and prevent the appearance of modchips or software jailbreaks.

2.2.3 Optimal Architectures for Complex Algorithms Implementations

Faculty J.L. Danger, P. Matherat, Y. Mathieu, L. Naviner, R. Pacalet, A. Polti

Main events NXP Semiconductor demonstrates Triscope project results at "Salon Européen de la Recherche & de l'Innovation". Invited conference at the Schloss Dagstuhl für Informatik GmbH.

Projects ANR SocLiB, ANR Asturies, ANR Telma, ANR Triscope, Bilateral Contract with STMicroeletronics for estimation of SER in Complex Systems, Bilateral contract with EDF for reliability improvement of systems implemented on FPGA

Architectures for image and multimedia processing: Video and image processing are more and more useful and required for numerous emerging services and applications but are often too computational expensive to reach real time on consumer devices (PCs, mobiles). On PCs platforms, we explored the usage a GPGPU (General Purpose Graphics Processing Unit) for a hardware accelerated multi-resolution and multi-prediction motion estimation algorithm used in real time video compression. This study led to very good performances [236] which are now confirmed by the success of the Compute Unified Device Architecture proposed by NVIDIA. Another weakness to note in the image processing on general purpose architectures is the inadequacy of cache memories architectures to the structured data organisation of multidimensional images. Furthermore, reconfigurable architectures (FPGA) designs are not well suited for complex cache management and leads to tedious developpement of ad-hoc memory management units. We proposed (ANR project Telma) a low-cost n-dimensional generic cache architecture for FPGA-Base image processing systems on chip exploiting spatial and temporal locality in a smarter manner than classical associative caches [234, 235]. Recent advances on high resolution LCD displays lead to emerging applications with 3D lenticular screens. In close partnership with NXP Semiconductor (granted through ANR project Triscope) we developed a real time hardware renderer for 3D LCD screens aimed to be the base for a full featured demonstrator for mobile 3D. For this purpose we designed a highly-integrated high-computational power embedded system (SHiX), featuring an embedded SuperH processor and a state of the art FPGA.

Architectures for communications: This activity is based on the global concept of reconfigurability. We defined a formal multilayer approach for reconfigurability in 3G systems. This formal framework was successfully applied to the DS-CDMA downlink detection giving a set of reconfigurable receivers appropriate for terminal implementations [168, 169, 268]. Time Interleaved High-Pass Sigma Delta converter (TIHP-$\Sigma\Delta$) assures the reconfigurability required by multistandard applications, but the digital processing inherent to this approach remains a bottleneck to achieve the ADC expected performances. We proposed a solution for signal reconstruction combining Comb-filter and decimation that reduces considerably computational requirements. Digital post-processing implementation based on our approach needs only a couple of integrators and differentiators [198].

Energy consumption of digital circuits and clockless systems: This research activity aims at modeling interactions between energy consumption of digital circuits, asynchronous circuits (with no global clock) and questions about algorithmic complexity. An initial work on dissipation of computation showed to us the links between language (computation) and matter (physical dissipation). This lead to the definition of "logical dissipation", and showed that a minimal dissipation is linked to modularity, on one hand modularity in space (composition of complex circuits from primitive gates), on the other hand modularity in time (questions about "synchronization"). A better practical knowledge of the dissipation question for the design of VLSIs could come from a better formalization of asynchronous circuits, seen as a general frame for defining digital electronic components [171].

Reliable architectures: The semiconductor scaling process is reaching some important limits that reflect negatively in the reliability of the integrated circuits. Some of these are manufacturing imprecision, improved susceptibility to environmental factors and physical parameters variability [172]. Our work deals with challenges related to such reliability decrease and has been developped in collaboration with the "Electronics and RF systems" team. During the period concerned by this report, we focused on development of efficient algorithms and tools for reliability assessment, which is crucial to establish cost-quality trade-offs related to different reliability improvement schemes [383].

Using a new 2×2 matrix signal representation, we proposed a method for reliability analysis based on the cumulative effect of errors in the signals of the circuit [163]. The proposed *Signal Probability Reliability* (SPR) model embeds the contribution of multiple simultaneous faults to the reliability of the circuit. We registered the developped software implementing the SPR algorithm [289]. We also developped a new approach to obtain the reliability information based on the circuit's capacity of logical masking. This *Probabilistic Binomial Reliability* (PBR) method associates fault-injection and simulation to determinate an analytical equation for the reliability [211]. With the reliability equation available, many types of analysis can be done, like the susceptibility of the circuit to single and multiple faults, the reliability of the circuit for any particular value of individual gates reliability [210, 173].

Both proposed PBR and SPR approaches give accurate reliability values while requiring less computation power than state-of-the art methods. Futhermore, the proposed methods allow several trade-offs between accuracy and computation complexity for reliability assessment.

2.2.4 Software Defined Radio

Faculty J-L Danger, R. Pacalet

Projects IDROMEL(ANR) , Low cost UWB (Orange Labs contract), PFMM (French cluster SCS, DGE)

Flexible architecture for the Software Defined Radio (SDR)

Nowadays mobile communication systems, operate in different radio spectrum, radio access technologies, and protocol stacks depending on the network being utilized. This gives rise to the need of a flexible hardware platform that would be capable of supporting all the different standards in the entire wireless communication frequency range. This platform shall of course be extremely power efficient.

In a large multi-projects[3] context we propose a generic baseband prototype architecture for SDR applications[250], subdivided into a high level control module and a digital signal processing engine.This architecture can be used, for instance, in cognitive radio contexts[227]. The DSP engine is a composition of highly configurable processing blocks, like a "Fourier transform/vector processing" block [243, 242] or a generic channel decoder [188, 187, 243, 251], each dedicated to specific algorithms based on the analysis of different standards. Most existing works in the field are based on specialized micro-processors (vector processors, VLIW, ASIP, etc.) and on advanced interconnects (Networks on Chip). Unfortunately these solutions are still usually above the maximum power budget for such applications. Our approach mainly consists in identifying a small set of very complex hardwired processing blocks that will take in charge 90 to 95% of the total baseband processing power in a very power-efficient way. Each block is highly parametrizable and is assisted by a minimal 8 bits micro-controller that allows it to run sequences of operations (e.g. channel estimation) from basic commands (Fourier transforms, component-wise products, etc.) The platform is open and the whole project will be distributed under the French equivalent of the GPL-LGPL open source licenses, both for hardware models and embedded software.

Low cost UWB receiver

In order to meet the low-cost constraints and be Software Defined Radio compliant, the studied Ultra Wide Band communication systems is based on "Impulse-radio" protocols. The analog

[3] IDROMel ANR/RNRT, PFMM (French cluster SCS, DGE), OpenAirInterface

part is made up of an antenna a Low noise amplifier and an energy detector which allows to meet the low cost requirement. The research challenge is to study complex algorithms to check the possibility to obtain high bit rate (around 100Mbps) even with a simple radio front end. In the frame of a collaboration with Orange Labs, the studies lead to three main results.
The first one is the probablistic equalizer which is based on accurate energetic channel model. This function runs jointly with an iterative channel decoder to improve the bit error rate [241].
The second result is the development of a new algorithm to estimate the energetic coefficients. This function takes advantage of the Expectation-Maximization algorithm (EM) to provide accurate energetic coefficients to the equalizer [240]. A simpler method based on a novel training sequence has been proposed [277]. The final result is an optimal architecture in a fixed point precision. The optimisation is partly based on a chi-square law approximation with a gaussian distribution. This implementation allows to meet the low-cost constraint of the digital implemenation [239, 238].

2.3 References

2.3.1 ACL: Articles in ISI-Indexed Journals

[160] L. Apvrille, P. De Saqui-Sannes, and F. Khendek. TURTLE-P: a UML profile for the formal validation of critical and distributed systems. *Journal on Software and Systems Modeling*, pages 1–18, July 2006.
[161] L. Apvrille, P. De Saqui-Sannes, R. Pacalet, and A. Apvrille. Un environnement de conception de systèmes distribués basé sur UML. *Annals of the Telecommunications*, 61(11/12):1347–1368, Nov. 2006.
[162] J.-L. Danger, S. Guilley, and P. Hoogvorst. High Speed True Random Number Generator based on Open Loop Structures in FPGAs. *Elsevier Microelectronics Journal*, 2009.
[163] D. Franco, M. Vasconcelos, L. Naviner, and J. F. Naviner. Signal probability for reliability evaluation of logic circuits. *Microelectronics Reliability Journal*, 48:1586–1591, Sept. 2008.
[164] S. Guilley, F. Flament, R. Pacalet, P. Hoogvorst, and Y. Mathieu. Secured CAD Backend Flow for Power-Analysis Resistant Cryptoprocessors. *IEEE Design & Test of Computers*, 24(6):546–555, Nov. 2007.
[165] S. Guilley, P. Hoogvorst, and R. Pacalet. A Fast Pipelined Multi-Mode DES Architecture Operating in IP Representation. *Integration, the VLSI Journal*, 40(4):479–489, July 2007.
[166] S. Guilley, S. Chaudhuri, L. Sauvage, P. Hoogvorst, R. Pacalet, and G. M. Bertoni. Security Evaluation of WDDL and SecLib Countermeasures against Power Attacks. *IEEE Transactions on Computers*, 57(11):1482–1497, Nov. 2008.
[167] F. Guilloud, E. Boutillon, J. Tousch, and J.-L. Danger. Generic Description and Synthesis of LDPC Decoders. *IEEE Transactions on Communications*, 55(11):2084–2091, Nov. 2007.
[168] I. Krikidis, J.-L. Danger, and L. Naviner. Flexible and reconfigurable receiver architecture for WCDMA systems with low spreading factors. *IEE Electronic Letters*, 41(1):22–24, Jan. 2005.
[169] I. Krikidis, J.-L. Danger, and L. Naviner. An iterative reconfigurability approach for WCDMA high-data-rate communications. *IEEE Wireless Communications Magazine*, 13(3):8–14, June 2006.
[170] L. B. S. Lima, F. M. De Assis, and L. A. B. Naviner. Arquitetura para um decodificador de códigos de hermite pela solução de uma equação chave. *Journal of Communications and Information Systems*, 21(1):1–14, Apr. 2006.
[171] P. Matherat. Où en est-on de la dissipation du calcul ? Retour à Bennett. *Annales des Télécommunications*, 62 (5-6):690–713, 2007.
[172] D. Teixeira Franco, J. F. Naviner, and L. Naviner. Yield and reliability issues in nanoelectronics. *Annals of Telecommunications*, 61(11-12), Nov. 2006.
[173] M. Vasconcelos, D. Franco, L. Naviner, and J. F. Naviner. Relevant metrics for evaluation of concurrent error detection schemes. *Microelectronics Reliability Journal*, 48:1601–1603, Sept. 2008.

2.3.2 ACLN: Articles in Other Refereed Journals

[174] P. Matherat. Notre façon moderne de voir est conditionnée par la camera obscura - Réflexion sur les fondements logiques de la perception et de la mesure. *Intellectica*, 2007/1(45):167–191, Dec. 2007.
[175] P. Matherat. Des doubles parenthèses de Jacques Lacan et des triples d'Alain Didier-Weill. *Insistance*, Sept. 2007.
[176] S. Mekki, J.-L. Danger, and B. Miscopein. On the implementation of a probabilistic equalizer for low-cost impulse radio uwb in high data rate transmission. *Scientific Research Publiching (SciRes), Wireless Sensor Network*, June 2009.
[177] L. Sauvage, S. Guilley, and Y. Mathieu. ElectroMagnetic Radiations of FPGAs: High Spatial Resolution Cartography and Attack of a Cryptographic Module. *TRETS (ACM Transactions on Reconfigurable Technologies and Systems)*, 2(1):1–24, Mar. 2009.

2.3.3 ASCL: Articles in journals without editorial commitee

[178] F. Flament. Les systèmes embarqués sont ils sûrs. *Telecom*, (152):126–127, Jan. 2009.
[179] P. Matherat. Qu'est-ce que voir ? Ou comment notre vision est conditionnée par la camera obscura. *HAL, archives-ouvertes du CNRS*, Oct. 2006.
[180] P. Matherat. Où en est-on de la dissipation du calcul ? retour à bennett. *HAL, archives-ouvertes du CNRS*, June 2006.
[181] P. Matherat. Le temps du calcul et le temps des ordinateurs. *HAL, archives-ouvertes du CNRS*, Aug. 2006.
[182] P. Matherat. Clockless components and relativity. *HAL*, May 2009.
[183] P. Matherat. Une histoire de la microélectronique. *CEL - Archives ouvertes*, June 2007.
[184] J. F. Naviner and L. Naviner. La sûreté de fonctionnement de systèmes nanoélectroniques : de nouveaux défis. *TELECOM*, (152), Jan. 2009.

2.3.4 ACTI: Articles in Proceedings of International Conferences

[185] S. Ahumada, L. Apvrille, T. Barros, A. Cansado, E. Madelaine, and E. Salageanu. Specifying Fractal and GCM Components With UML. In *XXVI International Conference of the Chilean Computer Science Society (SCCC'07)*, Iquique, Chile, Nov. 2007.
[186] L. Alves De Barros Naviner, M. Correia De Vasconcelos, D. Teixeira Franco, and J. F. Naviner. Efficient computation of logic circuits reliability based on probabilistic transfer matrix. In *IEEE DTIS2008 - Design and Technology of Integrated Systems*, Tozeur, Tunisie, Mar. 2008.
[187] E. Amador, R. Pacalet, and V. Rezard. Optimum LDPC Decoder: A Memory Architecture Problem. In *Design Automation Conference - DAC 2009*, San Fransisco, USA, July 2009.
[188] E. Amador, V. Rezard, and R. Pacalet. Energy Efficiency of SISO Algorithms for Turbo-Decoding Message-Passing LDPC Decoders. In *VLSI-SoC*, Florianopolis, Brazil, Oct. 2009. To appear.
[189] L. Apvrille. Ttool for diplodocus: An environment for design space exploration. In *8th annual international conference on New Technologies of Distributed Systems (NOTERE'2008)*, Lyon, France, June 2008.
[190] L. Apvrille and P. De Saqui-Sannes. Adding a methodological assistant to a protocol modeling environment. In *8th annual international conference on New Technologies of Distributed Systems (NOTERE'2008)*, Lyon, France, June 2008.
[191] L. Apvrille and P. De Saqui-Sannes. Making formal verification amenable to real-time uml practitioners. In *12th European Workshop on Dependable Computing*, Toulouse, France, May 2009.
[192] L. Apvrille, P. De Saqui-Sannes, and A. Apvrille. Une méthodologie de conception des systèmes distribués basée sur UML. In *NOuvelles TEchnologies de la REpartition (NOTERE) 2005*, Gatineau, Canada, Aug. 2005.
[193] L. Apvrille, P. De Saqui-Sannes, and F. Khendek. Synthèse d'une conception UML temps-réel à partir de diagramme de séquences. In *Colloque Francophone sur l'Ingéniérie des Protocoles*, Bordeaux, France, Mar. 2005.
[194] L. Apvrille, W. Muhammad, R. Ameur-Boulifa, S. Coudert, and R. Pacalet. A UML-based Environment for System Design Space Exploration. In *13th IEEE International Conference on Electronics, Circuits and Systems (ICECS'2006)*, Nice, France, Dec. 2006.
[195] L. Apvrille, S. Coudert, and C. Leduc. A framework for the formal verification of infinite systems. In *The 18th IEEE International Symposium on Software Reliability Engineering (ISSRE 2007)*, Trollhättan, Sweden, Nov. 2007.
[196] L. Apvrille, A. Mifdaoui, and P. De Saqui-Sannes. Nouvelle approche turtle pour le dimensionnement et la validation de systemes répartis temps réel. In *9th annual international conference on New Technologies of Distributed Systems (NOTERE'2009)*, Montreal, Canada, July 2009.
[197] D. Beautemps, L. Girin, N. Aboutabit, G. Bailly, L. Besacier, G. Breton, T. Burger, A. Caplier, M.-A. Cathiard, D. Chêne, J. Clarke, F. Elisei, O. Govokhina, C. Jutten, V. B. Le, M. Marthouret, S. Mancini, Y. Mathieu, P. Perret, B. Rivet, P. Sacher, C. Savariauw, S. Schmerber, J.-F. Sérignat, M. Tribout, and S. Vidal. TELMA : Telephony for the Hearing-Impaired People. from models to user tests. In *ASSISTH'2007*, Toulouse (France), Nov. 2007.
[198] A. Beydoun, V. T. Nguyen, L. Alves De Barros Naviner, and P. Loumeau. A 65 nm cmos digital processor for multi-mode time interleaved high-pass sigma-delta a/d converters. In *IEEE International Symposium on Circuits and Systems (ISCAS'09)*, Taipei, Taiwan, May 2009.
[199] T. Beyrouthy, A. Razafindraibe, L. Fesquet, M. Renaudin, S. Chaudhuri, S. Guilley, P. Hoogvorst, and J.-L. Danger. A Novel Asynchronous e-FPGA Architecture for Security Applications. In *ICFPT'07*, pages 369–372, Kokurakita, Kitakyushu, JAPAN, Dec. 2007.
[200] T. Beyrouthy, L. Fesquet, A. Razafindraibe, S. Chaudhuri, S. Guilley, P. Hoogvorst, J.-L. Danger, and M. Renaudin. A Secure Programmable Architecture with a Dedicated Tech-mapping Algorithm: Application to a Crypto-Processor. In *DCIS*, Grenoble, France, Nov. 2008.
[201] S. Bhasin, N. Selmane, S. Guilley, and J.-L. Danger. Security evaluation of different aes implementations against practical setup time violation attacks on fpgas. In *HOST (Hardware Oriented Security and Trust)*, pages 15–21, San Francisco, CA, USA, July 2009.
[202] D. Cardoso De Souza, I. Krikidis, L. Naviner, J.-L. Danger, M. De Barros, and B. Aguiar. Heterogeneous implementation of a rake receiver for DS-CDMA communication systems. In *IEEE International Conference on Electronics, Circuits and Systems (ICECS'05)*, pages 450–453, Gammarth, Tunisia, Dec. 2005.
[203] D. Cardoso De Souza, I. Krikidis, L. Naviner, J.-L. Danger, M. De Barros, and B. Aguiar. Implementation of a digital receiver for DS-CDMA communication systems using HW/SW codesign. In *IEEE Midwest Symposium on Circuits and Systems*, Cinccinati, Ohio, USA, Aug. 2005.

[204] M. Chami and Y. Mathieu. Etude d'accélération Matérielle pour Traitement Video: La norme h.264. In *Systèmes Electroniques - Informatiques & Traitement de l'Information*, pages 140–145, Mohammedia, Maroc, Jan. 2007.

[205] S. Chaudhuri, J.-L. Danger, S. Guilley, and P. Hoogvorst. FASE: An Open Run-Time Reconfigurable FPGA Architecture for Tamper-Resistant and Secure Embedded Systems. In *IEEE 3rd international conference on reconfigurable computing and FPGAs (ReConFig 2006)*, pages 1–9, San Luis Potosi, Mexico, Sept. 2006.

[206] S. Chaudhuri, J.-L. Danger, and S. Guilley. Efficient Modeling and Floorplanning of Embedded-FPGA Fabric. In *FPL*, pages 665–669, Amsterdam, Netherlands, Aug. 2007.

[207] S. Chaudhuri, J.-L. Danger, P. Hoogvorst, and S. Guilley. Efficient Tiling Patterns for Reconfigurable Gate Arrays. In *SLIP'08*, pages 11–18, Newcastle University, UK, Apr. 2008.

[208] S. Chaudhuri, S. Guilley, F. Flament, P. Hoogvorst, and J.-L. Danger. An 8x8 Run-Time Reconfigurable FPGA Embedded in a SoC. In *DAC*, pages 120–125, Anaheim, CA, USA, June 2008.

[209] S. Chaudhuri, S. Guilley, P. Hoogvorst, J.-L. Danger, T. Beyrouthy, A. Razafindraibe, L. Fesquet, and M. Renaudin. Physical Design of FPGA Interconnect to Prevent Information Leakage. In *ARC (Applied Reconfigurable Computing), Proceedings in LNCS Springer-Verlag Berlin Heidelberg*, volume 4943, pages 87–98, London, UK, Mar. 2008.

[210] M. Correia De Vasconcelos, D. Teixeira Franco, L. Naviner, and J. F. Naviner. On the output events in concurrent error detection schemes. In *IEEE International Conference on Electronics, Circuits, and Systems*, Malte, Sept. 2008.

[211] M. Correia De Vasconcelos, D. Teixeira Franco, L. Naviner, and J. F. Naviner. Reliability Analysis of Combinational Circuits Based on a Probabilistic Binomial Model. In *IEEE-NEWCAS and TAISA Conference*, Montréal, Canada, June 2008.

[212] M. Correia De Vasconcelos, D. Teixeira Franco, L. Naviner, and J. F. Naviner. Relevant metrics for evaluation of concurrent error detection schemes. In *European Symposium on Reliability of Electron Devices, Failure Physics and Analysis*, Maastricht - The Netherlands, Oct. 2008.

[213] J.-L. Danger, S. Guilley, and P. Hoogvorst. Fast True Random Generator in FPGAs. In *IEEE MWSCAS/NEWCAS'07*, pages 506–509, Montréal, Canada, Aug. 2007.

[214] B. Fontan, L. Apvrille, P. De Saqui-Sannes, and J.-P. Courtiat. Real-time and embedded system verification based on formal requirements. In *Industrial Embedded Systems 2006 (IES'2006)*, Antibes, France, Oct. 2006.

[215] B. Fontan, P. De Saqui-Sannes, and L. Apvrille. Génération automatique d'observateurs pour la vérification formelle d'exigences temporelles. In *7ème Conférence Internationale sur les NOuvelles TEchnologies de la REpartition, 7th International Conference on New Technologies of Distributed Systems, NOTERE 2007*, pages 541–542, Marrakech, Maroc, June 2007.

[216] B. Fontan, P. De Saqui-Sannes, and L. Apvrille. Timing requirement description diagrams for real-time system. In *4th International Conference on Embedded and Real Time Software (ERTS 2008)*, Toulouse, France, Jan. 2008.

[217] B. Fontan, P. De Saqui-Sannes, and L. Apvrille. Synthèse d'observateurs à partir d'exigences temporelles. In *14ème colloque International sur les Langages et Modèles à Objets (LMO 2008), Revue des Nouvelles Technologies de l'Information (RNTI-L-1)*, pages 187–203, Montreal, Canada, Feb. 2008.

[218] S. Guilley and P. Hoogvorst. The proof by $2^m - 1$: a low-cost method to check arithmetic computations. In *SEC 2005*, volume IFIP 181, pages 589–600, Chiba, JAPAN, May 2005.

[219] S. Guilley, P. Hoogvorst, Y. Mathieu, and R. Pacalet. The "Backend Duplication" Method. In *Workshop on Cryptographic Hardware and Embedded Systems*, volume LNCS 3659, pages 383–397, Edinburgh, Scotland, Aug. 2005.

[220] S. Guilley, P. Hoogvorst, R. Pacalet, and J. Schmidt. Improving Side-Channel Attacks by Exploiting Substitution Boxes Properties. In *International Conference on Boolean Functions: Cryptography and Applications (BFCA)*, pages 1–25, Paris, France, May 2007.

[221] S. Guilley, S. Chaudhuri, L. Sauvage, T. Graba, J.-L. Danger, P. Hoogvorst, V.-N. Vong, and M. Nassar. Place-and-Route Impact on the Security of DPL Designs in FPGAs. In *HOST (Hardware Oriented Security and Trust), IEEE; collocated with DAC'08*, volume ISBN = 978-1-4244-2401-6, pages 29–35, Anaheim, CA, USA, June 2008.

[222] S. Guilley, S. Chaudhuri, L. Sauvage, T. Graba, J.-L. Danger, P. Hoogvorst, V.-N. Vong, M. Nassar, and F. Flament. Shall we trust WDDL? In *Future of Trust in Computing*, volume 2, pages 208–215, Berlin, Germany, June 2008.

[223] S. Guilley, F. Flament, Y. Mathieu, and R. Pacalet. Security Evaluation of a Balanced Quasi-Delay Insensitive Library. In *DCIS*, Grenoble, France, Nov. 2008.

[224] S. Guilley, L. Sauvage, J.-L. Danger, T. Graba, and Y. Mathieu. Evaluation of Power-Constant Dual-Rail Logic as a Protection of Cryptographic Applications in FPGAs. In *SSIRI*, pages 16–23, Yokohama, Japan, July 2008.

[225] S. Guilley, L. Sauvage, J.-L. Danger, and P. Hoogvorst. Area Optimization of Cryptographic Co-Processors Implemented in Dual-Rail with Precharge Positive Logic. In *FPL (18th IEEE International Conference on Field-Programmable Logic and Applications)*, pages 161–166, Heidelberg, Germany, Sept. 2008.

[226] S. Guilley, L. Sauvage, J.-L. Danger, N. Selmane, and R. Pacalet. Silicon-level solutions to counteract passive and active attacks. In *FDTC, 5th workshop on Fault Tolerance and Detection in Cryptography, IEEE-CS*, pages 3–17, Washington, DC, USA, Aug. 2008.

[227] A. M. Hayar, R. Pacalet, and R. Knopp. Cognitive radio Research and Implementation Challenges. In *Asilomar Conference on Signals, Systems and Computer*, Monterey, USA, Nov. 2007.

[228] C. Jaber, A. Kanstein, L. Apvrille, A. Baghdadi, P. Le Moenner, and R. Pacalet. High-level system modeling for rapid hw/sw architecture exploration. In *20th IEEE/IFIP International Symposium on Rapid System Prototyping (RSP'2009)*, Paris, France, June 2009.

[229] H. Jouve, P. Le Gall, and S. Coudert. An automatic off-line method for interaction detection by static analysis of graphic feature specifications. In *8th International Conference on Feature Interactions in Telecommunications and*

Software Systems, ICFI'05, Leicester, UK, June 2005.
[230] M. Kafi, S. Guilley, S. Marcello, and D. Naccache. Deconvolving Protected Signals. In *ARES/CISIS - IEEE Computer Society*, pages 687–694, Fukuoka, Kyushu, Japan, Mar. 2009.
[231] F. Khelil, M. Hamdi, S. Guilley, J.-L. Danger, and N. Selmane. Fault Analysis Attack on an FPGA AES Implementation. In *NTMS*, pages 1–5, Tangier, Morocco, Nov. 2008.
[232] D. Knorreck, L. Apvrille, and R. Pacalet. Fast simulation techniques for design space exploration. In *47th International Conference Objects, Models, Components, Patterns*, volume 33, pages 308–327, Zurich, Switzerland, June 2009.
[233] I. Krikidis, J.-L. Danger, and L. Naviner. Reconfigurable implementation issues of a detection scheme for DS-CDMA high data rate connections. In *IEEE International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC'05)*, Berlin, Germany, Sept. 2005.
[234] Z. Larabi, Y. Mathieu, and S. Mancini. High Efficiency Reconfigurable Cache for Image Processing. In *Engineering of Reconfigurable Systems and Algorithms*, Las Vegas, USA, July 2009.
[235] Z. Larabi, Y. Mathieu, and S. Mancini. Efficient data access management for fpga-based image processing socs. In *20th International Symposium on Rapid System Prototyping (RSP'2009)*, Paris France, June 2009.
[236] S. Mazaré, R. Pacalet, and J.-L. Dugelay. Using GPU for fast block-matching. In *14th European Signal Processing Conference / EUSIPCO'06*, Florence, Italy, Sept. 2006.
[237] S. Mekki, J. Boutros, J.-L. Danger, B. Miscopein, and J. Schwoerer. EM algorithm development for M-PPM UWB Demodulation based on Energy Detection. In *UWB 2007*, Grenoble, May 2007.
[238] S. Mekki, J.-L. Danger, and B. Miscopein. A simplified implementation of a probabilistic equalizer for impulse radio uwb in high data rate transmission. In *ICSPCS*, Goald coast (Australia), Dec. 2008.
[239] S. Mekki, J.-L. Danger, B. Miscopein, and J. J. Boutros. Chi-squared distribution approximation for probabilistic energy equalizer implementation in impulse-radio uwb receiver. In *ICCS 2008*, Guangzhou, Nov. 2008.
[240] S. Mekki, J.-L. Danger, B. Miscopein, and J. J. Boutros. Em channel estimation in a low-cost uwb receiver based on energy detection. In *ICWCS*, Reykjavik, Oct. 2008.
[241] S. Mekki, J.-L. Danger, B. Miscopein, J. Schwoerer, and J. Boutros. Probabilistic equalizer for ultra-wideband energy probabilistic equalizer for ultra-wideband energy. In *VTC 2008*, Singapore, May 2008.
[242] N. Muhammad, K. Khalfallah, R. Knopp, and R. Pacalet. Reconfigurable DSP Architectures for SDR Applications. In *14th IEEE International Conference on Electronics, Circuits and Systems - ICECS'2007*, Marrakech, Morocco, Dec. 2007.
[243] N. Muhammad, R. Rasheed, R. Pacalet, R. Knopp, and K. Khalfallah. Flexible Baseband Architectures for Future Wireless Systems. In *DSD 2008, 11th EUROMICRO CONFERENCE on DIGITAL SYSTEM DESIGN. Architectures, Methods and Tools*, Parma, Italy, Sept. 2008.
[244] R. Muhammad, L. Apvrille, and R. Pacalet. Application specific processors for multimedia applications. In *11th IEEE International Conference on Computational Science and Engineering (CSE 2008)*, pages 109–116, Sao Paulo, Brazil, July 2008.
[245] R. Muhammad, L. Apvrille, and R. Pacalet. Evaluation of asips design with lisatek. In *8th International Workshop SAMOS*, volume 5114/2008, pages 177–186, Samos, Greece, July 2008.
[246] W. Muhammad, L. Apvrille, R. Ameur-Boulifa, S. Coudert, and R. Pacalet. Abstract Application Modeling for System Design Space Exploration. In *Euromicro Conference on Digital System Design*, Dubrovnik, Croatia, Aug. 2006.
[247] W. Muhammad, S. Coudert, R. Ameur-Boulifa, and R. Pacalet. Semantic Preserving RTL Transformation for Control-Data Slicing in Virtual IPs. In *11th IEEE International Multitopic Conference - INMIC 2007*, Lahore, Pakistan, Dec. 2007.
[248] W. Muhammad, S. Coudert, R. Ameur-Boulifa, and R. Pacalet. A Static Verification Technique based on Boolean Data Dependency Analysis in Hardware Modules. In *DASIP 2009*, Sophia-Antipolis, France, Sept. 2009. To appear.
[249] L. Naviner and K. Lenz. A new decoding architecture for algebraic-geometry codes. In *IEEE Midwest Symposium on Signal and Systems*, Cinccinati, Ohio, USA, Aug. 2005.
[250] D. Nussbaum, C. Moy, J. Martin, B. Mercier, and R. Pacalet. Open Platform for Prototyping of Advanced Software Defined Radio and Cognitive Radio Techniques. In *12th Euromicro Conference on Digital System Design, DSD 2009*, Patras, Greece, Aug. 2009. To appear.
[251] R. Rasheed, A. Menouni, and R. Pacalet. Reconfigurable Viterbi Decoder for Mobile Platform. In *7th IFIP International Conference on Mobile and Wireless Communications Networks (MWCN)*, Marrakech, Maroc, Sept. 2005.
[252] L. Sauvage, S. Guilley, J.-L. Danger, Y. Mathieu, and M. Nassar. Successful attack on an FPGA-based WDDL DES cryptoprocessor without place and route constraints. In *DATE*, pages 640–645, Nice, France, Apr. 2009.
[253] N. Selmane, S. Guilley, and J.-L. Danger. Practical Setup Time Violation Attacks on AES. In *EDCC, The seventh European Dependable Computing Conference*, pages 91–96, Kaunas, Lithuania, May 2008.
[254] N. Selmane, S. Bhasin, S. Guilley, T. Graba, and J.-L. Danger. Wddl is protected against fault attacks. In *FDTC (IEEE Fault Diagnosis and Tolerance in Cryptography)*, Lausanne, Switzerland, Sept. 2009. To appear.
[255] L. Su, S. Courcambeck, P. Guillemin, C. Schwarz, and R. Pacalet. SecBus: Operating System Controlled Hierarchical Page-Based Memory Bus Protection. In *Design Automation & Test in Europe - DATE 2009*, Nice, France, Apr. 2009.
[256] D. Teixeira Franco, M. Correia De Vasconcelos, R. De Vasconcelos, L. Alves De Barros Naviner, and J. F. Naviner. Reliability of logic circuits under multiple simultaneous faults. In *IEEE Midwest Symposium on Circuits and Systems*, Knoxville, TN, Etats-Unis, Aug. 2008.
[257] D. Teixeira Franco, M. Correia De Vasconcelos, L. Naviner, and J. F. Naviner. Signal probability for reliability evaluation of logic circuits. In *European Symposium on Reliability of Electron Devices, Failure Physics and Analysis*, Maastricht - The Netherlands, Oct. 2008.

[258] D. Teixeira Franco, M. Correia De Vasconcelos, L. Naviner, and J. F. Naviner. Reliability analysis of logic circuits based on signal probability. In *IEEE International Conference on Electronics, Circuits, and Systems*, Malte, Sept. 2008.
[259] D. Teixeira Franco, M. Correia De Vasconcelos, L. Naviner, and J. F. Naviner. Spr tool: Signal reliability analysis of logic circuits. In *Design, Automation and Test in Europe, DATE*, Nice, France, Apr. 2009.

2.3.5 ACTN: Articles in Proceedings of French Conferences

[260] L. Apvrille and P. De Saqui-Sannes. TURTLE: a UML-based environment for the codesign of embedded systems. In *SAME Sophia-Antipolis MicroElectronics*, Sophia-Antipolis, france, Sept. 2005.
[261] P. Matherat. L'écriture et le réchauffement de la Terre. In *Écritures: sur les traces de Jack Goody*, Lyon, Jan. 2008.

2.3.6 COM: Talks in Conferences Which Do Not Publish Proceedings

[262] L. Alves De Barros Naviner. Error and fault-tolerance in vlsi. In *Fault-Tolerant Distributed Algorithms in VLSI Chips*, Dagstuhl, Germany, Sept. 2008.
[263] P. Hoogvorst, S. Guilley, S. Chaudhuri, J.-L. Danger, A. Razafindraibe, T. Beyrouthy, L. Fesquet, and M. Renaudin. A Reconfigurable Cell for a Multi-Style Asynchronous FPGA. In *ReCoSoC*, pages 15–22, Montpellier, France, June 2007.
[264] Z. Larabi, Y. Mathieu, and S. Mancini. Optimization of the nD-AP Cache memory hierarchy. In *System On Chip - System In Package*, Paris France, June 2008.
[265] P. Matherat. Chambre noire et topologie. In *L'enclave à l'épreuve de la clinique*, Paris, Apr. 2009.

2.3.7 AFF: Posters in Conferences

[266] S. Chaudhuri, J.-L. Danger, P. Hoogvorst, and S. Guilley. Efficient Tiling Patterns for Reconfigurable Gate Arrays (poster session 1). In *FPGA*, page 257, Monterey, California, USA, Feb. 2008.

2.3.8 OS: Books and Book Chapters

[267] I. Krikidis, L. Naviner, and J.-L. Danger. *Approche Itérative pour la Réconfigurabilité Matérielle : Exemple du Récepteur RAKE*, chapter 5. Hermès, Paris, 2005.
[268] I. Krikidis, L. Naviner, and J.-L. Danger. *Iterative approach for hardware reconfigurability: the RAKE receiver*, chapter 5. ISTE, GB, 2007.
[269] L. A. B. Naviner, J. F. Naviner, D. T. Franco, and M. R. Vasconcelos. Methods and metrics for reliability assessment. In J. E. B. Charron-Bost, S. Dolev and U. Schmid, editors, *Fault-Tolerant Distributed Algorithms on VLSI Chips*, chapter 4, pages 1–14. Schloss Dagstuhl - Leibniz-Zentrum fuer Informatik, Germany, Dagstuhl, Germany, 2009.

2.3.9 DO: Journal or Proceedings Edition

[270] L. apvrille, K. Drira, P. de Saqui-Sannes, and T. Villemur, editors. *NOTERE'2006, Nouvelles Technologies de la Répartition*, 2006. Hermès, Lavoisier. ISBN 2-7462-1588-X.

2.3.10 AP: Other Productions: Database, Registred Software, Registred Patent, . . .

[271] L. Alves De Barros Naviner. Architectures Numériques pour les Télécommunications, HDR. Technical report, Université Pierre et Marie Curie, Paris, France, Nov. 2006.
[272] L. Apvrille. Procédé de mise à jour d'au moins un espace personnel de publication, terminal de communication, serveur intermédiaire et produit programme d'ordinateur correspondants. (06/11345), Nov. 2006.
[273] L. Apvrille. Ttool, 2005.
[274] J.-L. Danger and S. Guilley. Circuit de cryptographie protege contre les attaques en observation, notamment d'ordre eleve. (FR0950341), Jan. 2009.
[275] J.-L. Danger, S. Guilley, and F. Flament. Procede de detection d'anomalies dans un circuit de cryptographie protege par logique differentielle et circuit mettant en oeuvre un tel procede. (FR 08/55537), Aug. 2008.
[276] J.-L. Danger, S. Guilley, and P. Hoogvorst. Procédé de protection de circuit de cryptographie programmable et circuit protégé par un tel procédé. (FR 08 51904), Mar. 2008.
[277] J.-L. Danger, S. Mekki, and B. Miscopein. Procédé d'émission d'impulsions dans un canal de transmission. (FR08/58123), Nov. 2008.
[278] S. Guilley. *Contre-mesures Géométriques aux Attaques Exploitant les Canaux Cachés*. PhD thesis, École Nationale Supérieure des Télécommunications, ENST07E003, Jan. 2007.

[279] S. Guilley and J.-L. Danger. Circuit de cryptographie, protege notamment contre les attaques par observation de fuite d'information par leur chiffrement. (FR0950342), Jan. 2009.
[280] S. Guilley and J.-L. Danger. Test de circuits cryptographiques par analyse différentielle de consommation. (FR 08 51184), Mar. 2008.
[281] S. Guilley and A. D. Dao. Logiciel "genlut", Apr. 2008.
[282] S. Guilley and A. D. Dao. Logiciel "vDuplicate", Apr. 2008.
[283] S. Guilley, J.-L. Danger, and L. Sauvage. Procede de protection du decryptage des fichiers de configuration de circuits logiques programmables et circuit mettant en oeuvre le procede. (FR 08/55536), Aug. 2008.
[284] P. Hoogvorst, S. Guilley, and T. Graba. Logiciel "fpgasbox", July 2008.
[285] C. Leduc, S. Coudert, and L. Apvrille. Vérification de spécifications lotos basée sur la logique de description. Technical Report FR-0451844, ENST, Mar. 2007.
[286] W. Muhammad. *Assistance à l'Abstraction de Composants Virtuels pour la Vérification Rapide de Systèmes Numériques*. PhD thesis, Université de Nice Sophia-Antipolis, Jan. 2009.
[287] L. Naviner. State of the art in sensor networks (hardware issues for sensor network design). Technical Report CaptAdHoc, Groupe des Ecoles de Télécommunications, Mar. 2006.
[288] B. Russell and P. Matherat. Conséquences philosophiques de la relativité, 2008. Traduction en français par Philippe Matherat, de l'article original de Bertrand Russell (1926).
[289] D. Teixeira Franco, L. Naviner, and J. F. Naviner. Signal probabililty reliability analysis tool. (IDDN FR.001.450011.000.S.P.2008.000.20700), Nov. 2008.

Chapter 3

Electronics and RF Systems (ELECRF)

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F. Ziade (06/04–04/08), A. Latiri (07/04–06/08), M. Vahdani (10/04–10/08),
C. Mohamed (01/05–09/08), R. Mina (03/05–12/08), S. Martinez Lopez (09/05–09/08),
K. Mabrouk (12/05–12/08), M. Bahouche (02/06–), H. Khushk (09/06–),
W. Altabban (12/06–), M. Grelier (10/07–), C. Jabbour (10/07–),
F. Linot (11/07–), R. Mogharini (11/07–), F. Targino Vidal (12/07-),
D. Bibiano Brito (10/08–), A. Gruget (10/08–), P. Maris Ferreira (10/08–),
R. Mohellebi (10/08–), A. Thior (10/08–), Q. Chu (11/08–),
S. Kowlgi Srinivasan (04/09–), A. Maalej (01/09–).

Post-docs, engineers and sabbaticals

G.L. Abib (10/07–03/08), S. Bensmida (10/05–10/06), D. Camarero De La Rosa (07/07-12/08),
R. Guelaz (09/07–03/09), S. Hamieh (06/07–02/08), H. Fakhoury (06/08–06/09),
A. Beydoun (02/08–), A. Khy (05/05–).

Faculty IT	9.5
PhD students	13.8
Post-docs, engineers and sabbaticals	2.5
Defended PhD theses	19
Defended HDR	2
Journal papers [published, in press]	[23, 2]
Papers in conference proceedings	125
Chapters and books	3
Patents and software	[8, 1]
Grants [public, private, european] (k€)	[799, 420, 38]

3.1 Objectives

Our research deals with the integration of radiofrequencies devices for wireless mobile communication systems. The activity is supported by public and industrial fundings. The current developments are made in close interaction with companies like STMicroelectronics, NXP, CEA, Thales, Thales Alenia Space, Thales Airborne Systems, LNE, Orange Labs or Schneider Electric.

From reconfigurable RF front–end to software defined radio: The goal of the software defined radio is to shift the processing of the received signal into the digital domain with the analog to digital conversion immediately after the antenna. The “software defined radio” main interest is to facilitate standard reconfigurability using numerical processing and simple software downloading. Yet, the software defined radio calls for analog to digital conversion performances that are not currently achievable. Our work concentrates on the joint optimisation of analog and digital functions that would match the software radio feasibility criteria. Novel concepts of electronics architectures are demonstrated through the design, fabrication and test of innovative CMOS circuitries. The long term goal is the building of a software defined radio platform.

Nanoelectronics architectures and circuits: New applications require an increased level of hardware and software integration at chip level if one wants to keep a moderate manufacturing cost. The evolution towards nanoscale technologies for a higher transistor density is therefore essential in a highly competitive environment. However, at decananometric or nanometric scale, new physical phenomena must be taken into account and modelized. Our research covers the modeling and the evaluation of new nanodevices as well as the study of smart acquisition interfaces satisfying the requirements of performance and portability.

RF metrology: Increasing communication rates as well as more demanding requests on wireless systems calls for improved RF metrologies. Our work involves:

- The new definition of standards for the measurements of both RF power and RF scattering parameters in the frequencey range 1-18 GHz.
- The non-linear characterisation of power amplifiers in the frequency band 900 MHz - 10 GHz using numerical pre-distortion and source&load pull techniques.
- The sounding of indoor radio propagation channel in the ISM band 2.4 GHz.

Wireless communication systems technology: Our work on wireless communication systems technology concentrates on the so-called “RF front-end” which is one of the most sensitive part of communicating objects. It involves improved modulation/demodulations schemes as well as the study of novel antenna technologies applied to several wireless communication standards from 800 MHz to 40 GHz. The design of circuits for RF “Front-end” using MMIC or hybrid technology on GaAs or dielectric substrates is based on the three-phase “Zero IF” receiver. Concerning

the antenna design, the demand is currently on wideband and discrete structures in many application areas. Our research topics are focused on wideband and low-profile antennas and arrays. In the last few years, we developed and applied novel artificial materials for the antenna's reflector which has led to innovative and performant antennas. These materials are also used to reduce the coupling factor between the elements of an antenna array.

3.2 Main Results

The main research results obtained during the period 2005-2009 are presented below for the research areas of the "Electronics and RF systems" team.

3.2.1 From Reconfigurable RF Front-End to Software Defined Radio

Faculty P.Desgreys, V.T.Nguyen, H.Petit, J.F.Naviner, P.Loumeau

Main events Technical chairman of NEWCAS-TAISA09 IEEE International Conference, Coordinator of the project TEROPP between 6 Carnot Institutes and 3 Fraunhofer institutes, creation of the GIS eSys "Groupement pour l'Electronique des Systèmes".

Projects Versanum ANR-05-RNRT-010-01, TEROPP ANR-07-P2IC-O11 01, HyperSCAN ANR-06-TCOM-023-06.

Direct RF sampling and signal processing: Direct analog to digital conversion of the radio frequency (RF) signal is still unfeasible at present time, due to the high requirements imposed on the analog to digital converter. This motivates the need for a highly flexible RF front-end that can be fully integrated in low cost digital deep-submicron CMOS processes. Different techniques for shifting the RF and analog circuit design complexity to a digitally intensive domain were developed recently. A collaborative project with STMicroelectronics [299] was launched on direct RF sampling and discrete-time analog signal processing. The goal was greater flexibility and reduction of cost and power consumption in a reconfigurable design environment. To validate the flexibility and reconfigurability of the receiver, GSM and 802.11g communication standards have been addressed and adopted during system level study. The frequency plan and filtering scheme were made different for each standard to fully analyze and validate the flexibility of the architecture. A circuit designed and fabricated in 90nm CMOS technology was able to demonstrate the functionality of the receiver.

Non-uniform sampling: In the previous project, the first CMOS anti-alias filtering stage was improved but the costly discrete RF filter could not be suppressed. To deal with the suppression of RF anti-alias filtering, Non Uniform Sampling (NUS) based receiver architectures have been studied in a collaborative project with SUP'COM Tunis. We have demonstrated relaxed constraints on both RF filter and ADC dynamic power consumption using appropriate NUS architecture [307].

Analog to Digital Phase Locked Loop (ADPLL) : An RF synthesizer is another challenging block of a RF analog front-end. By replacing analog blocks, it allows simpler reconfigurability in the case of wideband and high resolution applications. In this context, an ADPLL architectures has been studied and modeled in order to minimize the jitter noise and facilitate the design reuse [290]. The architecture was then proposed to NXP who has fabricated a successful demonstration circuit in 65nm CMOS technology in a collaborative project with TELECOM ParisTech. The collaboration will continue with a new CIFRE thesis.

Software defined radio: The development of the software radio concept is still very much limited by the available resolution and speed of the analog-to-digital conversion stage. Parallel analog-to-digital converters (ADCs) seem to be the best suited way of increasing analog-to-digital conversion rates in complementary metal-oxide-semiconductor (CMOS) technologies. To demonstrate the feasibility of such a goal, a four-channel time-interleaved (TI) SD ADC has been implemented in an advanced 65 nm CMOS process [198]. The objective was an EDGE/UMTS/WLAN

tri-mode TI ADC with signal bandwidth from 135 KHz to 12,5 MHz and resolution from 8 bits to 13 bits. Three intrinsic problems must be overcome: gain-mismatch, offset-mismatch and clock-skew. Among these problems, clock-skew is the more challenging one. We have implemented and demonstrated experimentally a new Mixed-Signal Clock-Skew Calibration Technique based on a digitally trimmable multiphase sampling clock generator. This demonstrator can correct an initial clock skew of thousands of picoseconds with a granularity of 1.8 ps [294]. Three patents have been filed like [440], [448].

Opportunistic Radio: Cognitive radio systems are aiming at seamless mobile connectivity and optimum spectrum management. The ultimate evolution is the *opportunistic radio* where the intelligence and decision power are mostly on the terminal side. Ideally, a wide band RF front-end for future mobile opportunistic terminals must cover multiple standards and bands (from 400 MHz to 5 GHz), and is able to scan the spectrum to detect un-used bands. In this context the team coordinates the TEROPP project - Technologies for terminals in opportunistic radio applications - that associates six Carnot Institutes and three Fraunhofer Institutes. The team is implied in the co design and optimization of the wide band front end elements. This project started in January 2008 and the end will be in September 2011.

Disruptive technologies Disruptive technologies offer new ways to accomplish breakthroughs in cognitive and opportunistic radio. Based on superconductivity physics, the RSFQ (Rapid Single Flux Quantum) logic is a very low power consumption and ultra-fast electronic logic which is considered as the best alternative to CMOS in the ITRS for ultra high frequency applications. The team has proposed an RFSQ Analog to Digital architecture in a work conducted within the ANR Hyperscan project. The goal is a 2x8 bits and 500 MHz BW Sigma-Delta analog-to-digital converter (ADC or CAN) circuit with performance specifications to achieve space telecoms at 30 GHz carrier frequency. To verify the project feasibility, we have developped a model that implements superconductivity physics into the RFSQ ADC circuit simulation [433].

3.2.2 Nanoelectronics Architectures and Circuits

Faculty P.Desgreys, J.F.Naviner

Projects NANOSYS “Action Concertée Incitative CNRS”, NANO-RF (Institute Telecom incentive project), French-Brazilian project supported by CAPES and COFECUB.

Currently developped technologies in electronics have all entered the nanoscale area, and low dimension physical phenomena which need not be taken into account in the past cannot be anymore neglected in the design process. Disruptive technologies are emerging and may become alternatives or complements to the massively used CMOS technologies in the future [172].

In 2004, we began to study novel nanoscale technologies in order on one hand to propose new methods in the architecture and circuit design process and on the other hand to evaluate potentialities of emerging technologies compared to MOS technology. More precisely, the following axis were considered:

- portability of mixed-signal architectures to CMOS nanoscale technologies (collaboration with STMicroelectronics);
- reliability of mixed-signal architectures and circuits;
- device modelling, performance assessment and the comparison with MOS.

Note that the last two axis were initiated in the frame of the national Action Concertée Incitative NANOSYS whose objective was “Architectures pour l’intégration des nanocomposants moléculaires”.

Device modelling, performance assessment and comparison with MOS: Both fundamental and economical CMOS limits generate the need for complementary and alternative technologies, with molecular electronics among the most promising ones. In the framework of two projects NANOSYS (ACI) and NANO-RF (Institute Telecom incentive project) in 2006 and 2007, a compact model of Carbon Nanotubes Field-Effect Transistors (CNTFET) was developed in VHDL-AMS language [336] to explore the high-frequency performance of CNTFET. We have shown

that the cut-off frequency expected for a MOSFET-like CNTFET is well below the performance limit, due to the large parasitic capacitance between electrodes. Our model demonstrates that an array of parallel nanotubes combined in finger geometry to produce a single transistor channel significantly reduces the parasitic capacitance per tube and, thereby, improves the high-frequency performance.

Architectures for sensor devices: Supported by a French Brazilian CAPES/COFECUB project, we have developed research activities on the reconfigurability of sensor acquisition interfaces. Reconfigurability is needed to adapt the interface characteristics to those of a particular sensor, to those of the environment and to the particular type of measurement. These objectives are in some way a generalization of the calibration or self-calibration problems.
Our main target was the biomedical area where each patient's impedance is different. Yet, the measurement accuracy must be kept unchanged to allow for rigorous diagnosis and appropriate medical decisions. Our main result was the development of an automatic compensation method that deals with the impedance mismatch of electrodes in applications like ECG, EEG, etc. This thematic has now been integrated in the researches on reliability considering the convergent problematics [379], [380].

Reliability of mixed-signal architectures and circuits: Works on reliability of analog or mixed-signal architectures were initiated in Oct. 2008 with a PhD thesis. Considering that many circuits are today Systems-on-Chip (SoC), that they include often various analog or mixed-signal sub-circuits and that the reliability level of a SoC results from both the reliability of each sub-parts and the connections/interactions between them, our main objectives are:

- to assess the reliability of basic functions considering the physical causes of failures (ageing effects or other causes),
- to assess the reliability of an architecture working at an abstracted behavioural level,
- to compare basic functions circuitries and architectures on both performance and reliability criteria,
- to define methods of architecture/circuit design that includes the reliability in the design criteria.

The present work is focusing on the reliability of radio-frequency front-ends. After studying the causes of degradation and failures in nanoscale integrated circuits with ageing, we have been working on the reliability assesment of a Low-Noise Amplifier (LNA) given the reliability model of the constituting devices [362].

3.2.3 RF Metrology

Faculty X.Begaud, E.Bergeault, J.C. Cousin, B.Huyart

Main Events Organization of European Microwave Week in Paris on October 2005, Invited seminar on Radar Systems at Universidade Federal do Rio Grande de Norte Natal Brazil, October 2008.

Projects Bilateral project with LNE, Bilateral project with Orange Labs, Bilateral project with Schneider Electric, French-Brazilian project supported by CAPES and COFECUB, ANR Smartvision (Système multi senseur de détection d'objets cachés).

Power Standards: In the HF domain, the power standard is made of a calorimeter including a bolometric fixture. A power standard has been designed and fabricated in coplanar (CPW) waveguide technology with low return losses up to 8 GHz. A 3D electromagnetic simulation and measurements using TRL (Thru, Reflect, Line) calibration were performed. It allowed us to set the entire electrical model, including :

- the transition from the SMA connector to the CPW line
- the radiation
- the γ constant of propagation and the Zc characteristic impedance of the CPW line

- the DC-blocks

The obtained average deviation between the computed and measured efficiency by a micro calorimeter is less than 1.2%. The computed and the measured values are sufficiently close to open the way for a programmable HF power standard using our technology. [394], [395].

Standard Impedances for S-parameters measurements by a probe station: In the context of the design of Microwave Monolithic Integrated Circuits (MMIC), the devices characterisations should be performed on wafer for optimising the reliability and reducing the manufacturing cost. Valid S-parameters measurements with a probe station is however an open metrological challenge. In collaboration with the LNE institute, we realised and tested calibration kits associated to a TRA (Thru, Reflect, Attenuator) calibration method for probe station measurements [398, 395]. The main advantage of the TRA method in comparison with usual LRL (Line Reflect Line) method is the small size of the new standards. In that way, the manufacturer may add standards on the tested devices wafer to get the same electromagnetic propagation conditions between the calibration step and the test step.

Non-linear characterisation of power amplifier: Non linearities at the RF front-end level(power amplifiers for example) are a known source of impairment in wireless digital communications. It causes spectral spreading over adjacent channels and distorts the base band data. To reduce the distortion effects due to power amplifiers in the case of FSK, QPSK or 16 QAM modulated signals, we have successfully exploited a linearisation technique using a memoryless computed predistortion of the base band signals [314]. In order to study the impact of source and load impedances at the fundamental, the second harmonic and the low (base band) frequencies on the linearity, the efficiency and the level of transistors output power, a “sourcepull”-“load-pull” characterisation bench involving base band predistortion has been demonstrated [292, 315, 326, 293].

Radio communications channel sounding: The performances of a wireless propagation channel are strongly dependent on the propagation environment between the emitter and the receiver. A real time propagation channel sounder operating both in the time domain and the spatial domain is highly desirable for the complete characterisation of the channel specificities. Most sounders consist of virtual antenna array or actual antenna array with switches and few emitting elements. Furthermore, the output of the antenna is generally connected to a Vector Network Analyzer (VNA).
In contrast, we developed a sounder designed for non stationary MIMO channel. The sounder is formed by a linear array of 4 antennas at the emitter side and a linear array of 16 antennas at the receiver side. Each antenna is connected to a low cost zero IF receiver designed by our lab (see next section). The number of emitting elements permits to increase the range of Doppler frequency measurement and the precision on the AOA of the waves.
The current version of our sounder measures the angles of arrival (AOA) of impinging waves in the azimuth and elevation plans altogether with their time delays in indoor environments. In the case of non stationary channels, a chirp signal (FMCW) is used instead of step CW in order to reduce the acquisition time of the sounder [303]. To demonstrate the unique accuracy of the sounder in time-varying environments, we carried out an experimentation with an emitter moving at a speed of 1.1m/s along a rail parallel to the receiver antenna array. The Doppler frequency was measured with a precision of 0.2 Hzs [363].
The angles of departure of the emitted waves are determined using a virtual array of a 4 antennas. In that case, the channel is assumed to be stationary [364]. The sounder operates in the frequency range 2.1-2.8 GHz which is the bandwidth of the quasi Yagi antenna we have designed. The time and angle resolutions of the sounder are respectively 0.5ns and 2° using sub space methods (MUSIC, ESPRIT).
The correlation between the orthogonally polarized waves must also be characterized if the designer wants to exploit polarisation diversity. The quasi Yagi antennas have been replaced by a home designed array of 4 double patch antennas which covers up to 500 MHz around 2.45 GHz with double polarisation capability. A 2-paths scenario was emulated in an anechoic chamber and joint time delay, direction of arrival and polarization estimation were performed. The discrepancies between theoretical and experimental values are less than 0.2 ns and 10° [365].

A second research activity concerns the design of a channel sounder for Ultra Wide Band (UWB) applications. A UWB RF receiver using microstrip technology on FR4 substrate and UWB antennas have been codesigned in the frequency range 6-8.5-GHz [338]. Presently, the SIMO channel sounder consists of 8 receivers. Preliminary experimental results performed in an anechoic chamber demonstrate an accuracy of 2° for the AOA (Angle of Arrival) azimuth and 0.1 ns for the delay [339].

A third research activity was the realisation of a MIMO platform which was derived from the sounder by replacing the FMCW source by 2 modulated sources of same frequency 2.4 GHz. Beamforming was used in order to recover the signal of each source and improve the link quality in a spatial multiplexing mimo system [319].

Radar Applications: The aim was the design of a short range (1 m) radar operating in the 2.45 Ghz ISM band for low cost operation. The challenges for such radar are the detection of close targets using a signal of limited frequency bandwidth (80 MHz) and the rejection of unwanted signals in a widely used electromagnetic band. Using our work on demodulation techniques, a new radar architecture was designed based on a coded BPSK signal and the phase difference detection of successive carrying signals) [367]. This work has been done in collaboration with Schneider Electric and protected by two patents [442].

3.2.4 Wireless Communication Systems Technology

Faculty X.Begaud, B. Huyart, A.C.Lepage

Main events PhD Award of the Thales AirBorne Systems (2006, L. Schreider); UWB Autumn's School: Communications, Localization and Radar (23th-27th October 2006, Valence, France) in the framework of GDR ONDES, CNRS with X.Begaud (General Chairman).

Projects CONRAHD/OPTIMUM (CONnexion Radio sans fil Haut Débit) from the French Cluster "SYSTEM@TIC PARIS-REGION", bilateral projects with Thales Airborne Systems (2) and Thales Air Systems (1); PUMA (Produit Ultra haut débit sur bande millimétrique) from the French Cluster "SYSTEM@TIC PARIS-REGION"

MMIC design for RF "front-end":

Within the framework of CONRAHD/OPTIMUM, we realised the design and the tests of an integrated mixer circuit on GaAs in the 40.5-43.5 GHz frequency bandwidth. This resistive up-converter mixer is dedicated to Local Multipoint Distribution Service (LMDS) applications for short ranges, multi users, multi applications or multi communication standards. The mixer is the most linear device reported so far in this bandwidth in the up-converter mode [356].

For software defined radio applications, we have designed a Zero-IF three-phase demodulator in MMIC technology operating in the 1-24 GHz bandwidth to solve the problems of multi standards management [414, 443]. The main contributions were in the design of phase shifters and distributed mixers which can operate in such very large bandwidth.

Another three-phase demodulator and a classical IQ demodulator using Gilbert cell have also been designed and compared around 40 GHz [439]. They demonstrated direct demodulation of high frequencies signals (upper than 40 GHz) to base band signals. We proved that the use of Zero-If three-phase demodulator cancelled naturally the DC offsets as well as many damaging non linearities effects for the reception sensibility of a Zero-If demodulator [441]. An original calibration algorithm, based on blind technique using an unknown signal for homodyne receivers, was developed to reduce significantly the physical and signal processing stresses in the case of software radio applications [302]. The results were further improved using a bytes synchronisation method for blind-calibrating the demodulator and taking into account the defaults introduced by the propagation channel [360].

Wide band antennas design: The RF team's research is devoted to the design of wideband antennas and arrays. We initially focused our work on UWB (UltraWideBand) applications. While most UWB studies concentrate on omnidirectional antennas, we developed a unique compact,

directive UWB antenna with excellent performance both in frequency-domain and time-domain between 3.1 and 6 GHz [301]. The directive UWB antenna enables a 6 dB improvement in the budget link, a key feature in UWB considering the low power level of the emitted signal.

Following these results, we concentrated on the design of novel artificial materials to reduce the thickness of wideband antennas. The developed materials exploit periodic structures in order to exhibit the behaviour of an Artificial Magnetic Conductor (AMC) as well as that of an electromagnetic band-gap (EBG) structure. We designed a novel reflector that could demonstrate a wideband AMC behaviour (no phase shift on the reflected electric field) over a decade. By placing a radiating element very close to this reflector, we conceived the world's first antenna which is able to work over a decade with a thickness of one hundredth of the wavelength of the lowest frequency. This work has led to a patent [450] and has received the Thales Aerospace Division's PhD Award in 2006.
Our current challenge is to improve the radiation efficiency and the gain of these antennas. We are developing a new methodology that takes into account the interaction between the radiating element and its artificial ground plane. We are also considering refined characterizations of the artificial material itself, a necessary step for improving our control on the phenomena occurring in these metamaterials [343, 384]. Finally, we are applying our artificial materials to the problem of reducing the coupling between elements in a wideband antennas array, with a focus on analytical models [358].

Most wideband antennas, eg. spiral or sinuous antennas, require a balanced feeder which is generally bulky. Recently, we demonstrated a compact wideband coplanar balun for dual polarized compact antennas. We proved in this work that it is possible to design a small size feeder closed with a radiating surface [451].

3.3 References

3.3.1 ACL: Articles in ISI-Indexed Journals

[290] W. Altabban, P. Desgreys, and H. Petit. Behavioral model of LC VCO with LTV phase noise in VHDL-AMS. *Transactions on Systems, Signals and Devices*, 3(4):445–468, Dec. 2008.
[291] S. Ben Salem, M. Fakhfakh, D. Masmoudi, M. Loulou, P. Loumeau, and N. Masmoudi. A high performances CMOS CCII and high frequency applications. *Analog Integrated Circuits and Signal Processing*, 49(1):71 – 78, Oct. 2006.
[292] S. Bensmida, E. Bergeault, G. I. Abib, and B. Huyart. Power amplifier characterization : An active load-pull system based on six-port reflectometer using complex modulated carrier. *IEEE Transactions on Microwave Theory and Techniques*, 54(6):2707–2712, June 2006.
[293] S. Bensmida, E. Bergeault, and G. Berghoff. Measurements under pulsed rf and complex modulated signals using six-port reflectometers. *IEEE Transactions on Instrumentation and Measurement*, 56:pp. 2164–2168, Dec. 2007.
[294] D. Camarero, K. B. Kalaia, J. F. Naviner, and P. Loumeau. Mixed-signal clock-skew calibration technique for time-interleaved adcs. *IEEE Transactions on Circuits and Systems I : Regular Papers*, 55(11):3676 – 3687, Dec. 2008.
[295] F. R. De Sousa, B. Huyart, and S. Y. Catunda. A to d converters and look-up tables dimensioning for systems based on six-or five-port interferometers. *IEEE Transactions on Instrumentation and Measurement*, 54(3):1254–1259, June 2005.
[296] H. Ghannoum, C. Roblin, and X. Begaud. Investigation and Modeling of the UWB On-Body Propagation Channel. *Wireless Personal Communications Journal*, May 2008.
[297] A. Kazemipour and X. Begaud. Calculable dipole antenna for EMC measurements with low-loss wide-band balun from 30mhz to 2ghz. *Electromagnetics*, 25(3):187–202, Apr. 2005.
[298] A. Kazemipour and X. Begaud. Analytical study of printed dipoles with closed-form impedance formulas. *Microwave and Optical Technology Letters*, 45(4):345–347, Apr. 2005.
[299] A. Latiri, L. Joet, P. Desgreys, and P. Loumeau. A Reconfigurable RF Sampling Receiver for Multistandard Applications. *Comptes Rendus Physique*, 7(7):785 – 793, Sept. 2006.
[300] A. Latiri, L. Joet, P. Desgreys, and P. Loumeau. Passive second-order anti-aliasing filter for RF sampling based receivers. *ELECTRONICS LETTERS*, 43(1), Jan. 2007.
[301] A. C. Lepage, X. Begaud, G. Le Ray, and A. Sharaiha. UWB directive triangular patch antenna. *International Journal of Antennas and Propagation*, Jan. 2008.
[302] K. Mabrouk and G. Neveux. Three-dimensional aspect in the five-port technique for zero-if receivers and a new blind calibration method. *IEEE MTT*, 56(6):1389–1396, June 2008.
[303] S. Martinez Lopez, A. Judson Braga, H. Elarja, B. Huyart, and J. C. Cousin. High-Resolution Estimation using a Chirp Signal for Mobile Wideband MIMO Channel Sounding. *European Transactions on Telecommunications*, 2007.

[304] S. Martinez Lopez, J. Braga, B. Huyart, and J. C. Cousin. Multiplexing technique for dod and doa estimation. *IET Microwaves, Antennas & Propagation*, Dec. 2008.
[305] C. Mohamed, A. Khy, and B. Huyart. A (1-20 ghz broadband mmic demodulator for low if receivers in multi-standard applications. *IEEE Microwave Theory and Techniques*, Jan. 2009.
[306] F. Rangel De Sousa and B. Huyart. Five port receiver with improved sensitivity. *Microwave and Optical Technology Letters*, 50(11):2945–2947, Nov. 2008.
[307] C. Rebai, M. Ben Romdhane, P. Desgreys, P. Loumeau, and A. Ghazel. Pseudorandom signal sampler for relaxed design of multistandard radio receiver. *Microelectronics Journal*, 40:991–999, June 2009.
[308] L. Schreider, X. Begaud, M. Soiron, B. Perpere, and C. Renard. Broadband archimedean spiral antenna above a loaded electromagnetic band gap substrate. *IET Microwaves, Antennas & Propagation*, 1(1):212–216, Feb. 2007.
[309] A. Sibille, C. Roblin, S. Bories, and A. C. Lepage. A channel-based statistical approach to antenna performance in uwb communications. *IEEE Transactions on Antennas and Propagation*, 54(11):3207–3215, Nov. 2006.
[310] M. Vahdani and X. Begaud. Wideband integrated cps-fed dual polarized quasi bow-tie antenna. *Microwave and Optical Technology Letters*, 51(9), Sept. 2009. To appear.
[311] V. Y. Vu, A. J. Braga, X. Begaud, and B. Huyart. Measurement of direction-of-arrival of coherent signals using five-port reflectometers and quasi-yagi antennas. *IEEE Microwave and Wireless Component Letters*, 15(9):558–560, Sept. 2005.
[312] V. Y. Vu, A. Kohmura, J. Braga, X. Begaud, and B. Huyart. Simplified propagation channel characterization considering the disturbance of antennas in the case of a multi-path cluster. *Microwave and Optical Technology Letters*, 50(10):2604–2608, Oct. 2008.
[313] S. Zouari, H. Daoud, M. Loulou, P. Loumeau, and N. Masmoudi. High order cascade multibit ΣΔ modulator for wide bandwidth applications. *INTERNATIONAL JOURNAL OF ELECTRONICS, CIRCUITS AND SYSTEMS*, 1(1):60 – 66, 2007.

3.3.2 ACTI: Articles in Proceedings of International Conferences

[314] G. I. Abib, E. Bergeault, S. Bensmida, and B. Huyart. A source-pull/load-pull measurement system including power amplifier linearization using simple instantaneous memoryless polynomial base-band predistortion. In *EUropean Microwave Week*, Manchester, Sept. 2006.
[315] G. I. Abib, S. Bensmida, E. Bergeault, and B. Huyart. Experimental characterization of power transistors for linearity optimization. In *EUMW 2008*, Amsterdam, Oct. 2008.
[316] W. Altabban, P. Desgreys, and H. Petit. Time dependent phase noise model for LC VCO using VHDL-AMS. In *IEEE Int. Conf. on Sensors, Circuits and Instrumentation Systems*, Hammamet, Tunisia, Mar. 2007.
[317] M. Bahouche, D. Allal, and E. Bergeault. A simple impedance correction for on-wafer tan calibration techniques. In *Conference on Precision Electromagnetic Measurement (CPEM)*, Broomfield, USA, June 2008.
[318] X. Begaud. Ultra wideband wide slot antenna with band-rejection characteristics. In *Eucap 2006*, Nice France, Nov. 2006.
[319] H. Ben Maad, S. Sallem, K. Mabrouk, and B. Huyart. Improvement of the link quality in a spatial multiplexing mimo system using beamforming. In *EUMC*, Amsterdam, Oct. 2008.
[320] M. Ben Romdhane, C. Rebai, A. Ghazel, P. Desgreys, and P. Loumeau. Non-Uniform Sampling Schemes for IF Sampling Radio Receiver. In *Design and Test of Integrated Systems*, Tunis, Tunisia, Sept. 2006.
[321] M. Ben Romdhane, P. Desgreys, P. Loumeau, C. Rebai, and A. Ghazel. Intérêt et applications de l'echantillonnage non-uniforme pour les récepteurs radio multistandard. In *TAISA*, Lyon France, Oct. 2007.
[322] M. Ben Romdhane, C. Rebai, K. Grati, A. Ghazel, G. Hechmi, P. Desgreys, and P. Loumeau. NON-UNIFORM SAMPLED SIGNAL RECONSTRUCTION FOR MULTISTANDARD WiMAX/WiFi RECEIVER. In *IEEE Int. Conf. on Signal Processing and Communications*, Dubaï, United Arab Emirates, Nov. 2007.
[323] M. Ben Romdhane, C. Rebai, A. Ghazel, P. Desgreys, and P. Loumeau. Low power data conversion based on non uniform sampling for multistandard receiver. In *IEEE DTIS2009*, Cairo, Egypt, Apr. 2009.
[324] M. Ben Romdhane, C. Rebai, A. Ghazel, P. Desgreys, and P. Loumeau. Pseudorandomly controlled adc characterization towards multistandard receiver. In *IEEE Int. Conf. on Sensors, Circuits and Instrumentation Systems SSD'09*, Djerba, Tunisia, Mar. 2009.
[325] S. Bensmida, E. Bergeault, G. I. Abib, and B. Huyart. Power amplifier characterization : An active load-pull system based on six-port reflectometer using complex modulated carrier. In *EUropean Microwave Week*, Paris, Oct. 2005.
[326] S. Bensmida, F. M. Ghannouchi, and E. Bergeault. An original setup for power amplifier am-am and am-pm characterization. In *nstrumentation and Measurement Technology Conference Proceedings,IMTC 2008*, Vancouver, Canada, May 2008.
[327] A. J. Braga, V. Y. Vu, B. Huyart, and J. C. Cousin. Wideband spatio-temporal channel sounder using music and enhanced 2d-ss. In *European Conference of Propagation and Systems*, Brest, Mar. 2005.
[328] A. J. Braga, V. Y. Vu, B. Huyart, and J. C. Cousin. Beamforming system using five-port discriminator. In *European Conference on Wireless Technology 2005*, Paris, Oct. 2005.
[329] A. J. Braga, V. Y. Vu, B. Huyart, and J. C. Cousin. Smart antennas using five-port reflectometer. In *International Microwave and Optoelectronics Conference*, Brasilia (Brésil), July 2005.
[330] D. Camarero, J. F. Naviner, and P. Loumeau. Calibration of sampling instants in a multiple channel time-interleaved. In *IEEE International Conference on Electronics, Circuits and Systems*, La Marsa, Tunisie, Dec. 2005.
[331] D. Camarero, K. Ben Kalaia, J. F. Naviner, and P. Loumeau. Mixed-signal clock-skew calibrator for time-interleaved analog-to-digital converters. In *Design, Automation and Test in Europe, DATE*, Nice, France, Apr. 2007.

[332] D. Camarero De La Rosa, J. F. Naviner, and P. Loumeau. Calibration of sampling instants in a multiple channel time-interleaved analog-to-digital converter. In *IEEE International Conference on Electronics, Circuits and Systems, ICECS 2005.*, Gammarth, Dec. 2005.
[333] S. Y. C. Catunda, J. F. Naviner, R. C. S. Freire, and G. A. L. Pinheiro. Programmable gain and dc level shift analog signal conditioning circuit: Microcontroller based implementation. In *IMTC 2005 IEEE Instrumentation and Measurement Technology Conference*, Ottawa, Canada, May 2005.
[334] J. C. Cousin, N. Samama, and A. Vervisch-Picois. An indoor positioning system using GPS repeaters and AOA measurements. In *ION GNSS 2005*, Long Beach (USA), Sept. 2005.
[335] J. I. S. De Oliveira, S. Y. C. Catunda, A. K. Barros, and J. F. Naviner. Multi-layer level measurement using adaptive filtering. In *IMTC 2005 - IEEE Instrumentation and Measurement Technology Conference*, Ottawa, Canada, May 2005.
[336] P. Desgreys, J. Gomes Da Silva, and D. Robert. Dispersion Impact on Ballistic CNTFET N+-I-N+ Performances. In *European Nano Systems 2006*, Paris, France, Dec. 2006.
[337] P. Desgreys, R. Guelaz, and P. Loumeau. Band-pass sigma-delta adc design in rsfq technology. In *6ème journées " Dispositifs supraconducteurs " Journées SUPRA 2009*, Fréjus, France, May 2009.
[338] H. El Arja, K. Mabrouk, B. Huyart, and X. Begaud. Wideband demodulator for uwb channel sounder. In *38th European Microwave Conference 2008*, Amsterdam Pays-Bas, Oct. 2008.
[339] H. El Arja, K. Mabrouk, B. Huyart, and x. begaud. Joint toa/doa measurements for uwb indoor propagation channel using music algorithm. In *European Microwave Conference 2009, EUMC*, Rome , Italie, Sept. 2009.
[340] H. Fakhoury, C. Jabbour, H. Khushk, V. T. Nguyen, and P. Loumeau. A 65nm cmos edge/umts/wlan tri-mode four-channel time-interleaved sd adc. In *Joint Conference IEEE NEWCAS - TAISA'09*, Toulouse France, June 2009.
[341] H. Ghannoum, C. Roblin, and X. Begaud. Investigation of the UWB On-Body Propagation Channel.
[342] H. Ghannoum, R. D'Errico, C. Roblin, and X. Begaud. Characterization of the UWB on-body propagation channel. In *Eucap 2006*, Nice France, Nov. 2006.
[343] M. Grelier, X. Begaud, and L. Schreider. Loaded electromagnetic band gap reflector with a thin film resistor. In *META'08 & NATO ARW*, Marrakesh, Maroc, May 2008.
[344] R. Guelaz, P. Desgreys, and P. Loumeau. A sigma-delta bandpass ADC modelling in superconducting rsfq technology with VHDL-AMS. In *Forum On Design and Languages 2008*, Stuttgart-Allemagne, Sept. 2008.
[345] R. Guelaz, P. Desgreys, P. Loumeau, and P. Febvre. RSFQ comparator behaviour modelling for sigma-delta bandpass ADC. In *Conference on Design of Circuits and Integrated Systems*, Grenoble-France, Nov. 2008.
[346] R. Guelaz, P. Desgreys, and P. Loumeau. Superconducting circuits design tool: Application to high frequency sigma delta ad. In *University Booth at DATE09*, Nice, Apr. 2009.
[347] Y. Hervé and P. Desgreys. "Functional Virtual Prototyping Design Flow and VHDL-AMS. In *Forum on specification & Design Languages*, Darmstadt, Germany, Sept. 2006.
[348] C. Jabbour, D. Camarero, V. T. Nguyen, and P. Loumeau. Optimizing the number of channels for time-interleaved sample-and-hold circuits. In *IEEE NEWCAS-TAISA'08 Conference*, pages 245 – 248, Montréal, Canada, June 2008.
[349] A. Kazemipour and X. Begaud. Novel bi-polarization broadband wire antenna. In *2006 IEEE APS International Symposium*, Albuquerque USA, July 2006.
[350] A. Kazemipour and X. Begaud. Simple closed-form formula for the impedance of printed dipole. In *2005 IEEE AP-S International Symposium*, Washington DC, July 2005.
[351] A. Kazemipour and X. Begaud. Standard electromagnetic compatibility (emc) measurements, feasibility of a wideband calculable antenna. In *2008 URSI General Assembly*, Chicago, USA, Aug. 2008.
[352] A. Kazemipour, D. Allal, and X. Begaud. Roughness of the ground-plane and its effect on the antenna calibration in an open-field site. In *URSI GA 2005*, New Delhi, Inde., Oct. 2005.
[353] A. Kazemipour, X. Begaud, and D. Allal. E-Field Measurement, Accuracy and Uncertainties. In *Electromagnetic Compatibility and Electromagnetic Ecology, 2007 7th International Symposium on*, pages 189–191, Saint-Petersburg Russia, June 2007.
[354] H. A. Khushk, V. T. Nguyen, and P. Loumeau. Improved cascaded delta-sigma architecture with high signal to noise ratio and reduced distortion. In *IEEE NEWCAS-TAISA'08 Conference*, pages 201 – 204, Montréal, Canada, June 2008.
[355] A. Khy and B. Huyart. A 94 GHz radar using a six-port reflectometer as a phase/frequency discriminator. In *EuRad2005*, Paris, Oct. 2005.
[356] A. Khy, B. Huyart, and H. Teillet. A highly linear (40.5 - 43.5) ghz mmic single balanced phemt resistive up-converter mixer for lmds applications. In *EUMC 2008*, Amsterdam , Pays Bas, Oct. 2008.
[357] A. Latiri, L. Joet, P. Desgreys, and P. Loumeau. Récepteur à échantillonnage RF reconfigurable pour applications multistandards. In *Journées scientifiques "vers des radiocommunications reconfigurables et cognitives"*, Paris, France, Mar. 2006.
[358] F. Linot, X. Begaud, M. Soiron, C. Renard, and B. Perpere. Mutual coupling reduction using a thin modified electromagnetic band gap. In *META'08 & NATO ARW*, Marrakesh, Maroc, May 2008.
[359] K. Mabrouk, C. Mohamed, B. Huyart, X. Begaud, and S. Abou Chakra. A practical DIDO communication platform. In *European Conference on Wireless Technology 2006 IEEE*, Manchester UK, Sept. 2006.
[360] K. Mabrouk, B. Huyart, X. Begaud, and A. Belhadjmohamed. Baseband to baseband calibration for MIMO wireless system. In *European Conference on Wireless Technology 2007 IEEE*, Munich, Allemagne, Oct. 2007.
[361] P. Maris Ferreira, H. Petit, and J. F. Naviner. Conception de circuit rf pour la fiabilité. In *Journées Nationales du Réseau Doctoral de Microélectronique*, Lyon, France, May 2009.

[362] P. Maris Ferreira, H. Petit, and J. F. Naviner. Cmos 65nm wideband lna reliability estimation. In *IEEE NEWCAS - TAISA*, Toulouse, France, June 2009.
[363] S. Martinez Lopez, J. A. Braga, H. Elarja, B. Huyart, and J. C. Cousin. High-resolution estimation using a chirp signal for wideband MIMO channel sounding. In *13th European Wireless 2007*, Paris, Apr. 2007.
[364] S. Martinez Lopez, B. Huyart, and H. Elarja. A novel method for direction of departure estimation using a linear frequency modulated signal. In *EuMc 2007*, Munich, Oct. 2007.
[365] S. Martinez Lopez, A. Judson Braga, B. Huyart, and J. C. Cousin. Polarization measurement results for wideband multi-target RADAR using five-port receivers. In *IEEE Radarcon 2008*, Rome (Italie), May 2008.
[366] S. Masmoudi, M. Fakhfakh, M. Loulou, N. Masmoudi, and P. Loumeau. A CMOS 80 MHz Low-Pass Switched-Current Fourth Order Sigma Delta Modulator. In *IEEE Int. Conf. on Sensors, Circuits and Instrumentation Systems*, Hammamet, Tunisia, Mar. 2007.
[367] I. Masri, B. Huyart, J. C. Cousin, and T. Boudet. Short range detector of static or mobile targets in the 2.45 GHz ISM band. In *EUMW / EURAD*, Manchester (Angleterre), Sept. 2006.
[368] R. Mina, J. C. Grasset, and J. F. Naviner. Impact of charge injection on system-level performance of a discrete-time GSM Receiver. In *IEEE International Conference on Electronics, Circuits and Systems*, Nice, France, Dec. 2006.
[369] C. Mohamed, K. Mabrouk, S. Abou Chakra, and B. Huyart. Interference rejection in a five-port homodyne receiver. In *Eumc 2006*, Manchester (Angleterre), Sept. 2006.
[370] V. T. Nguyen, P. Loumeau, and J. F. Naviner. VHDL-AMS behavioral modelling and simulation of high-pass delta-sigma modulator. In *BMAS*, San Jose, Californie, Etats Unis, Sept. 2005.
[371] V. T. Nguyen, P. Desgreys, J. F. Naviner, and P. Loumeau. Noise analysis in high-pass delta sigma modulator. In *IMTC 2006*, Sorrente, Italie, Apr. 2006.
[372] V. T. Nguyen, J. F. Naviner, and P. Loumeau. High-pass delta sigma modulator: From system analysis to circuit design. In *ISCAS 2006*, Kos, Grèce, May 2006.
[373] V. T. Nguyen, J. F. Naviner, and P. Loumeau. A CMOS implementation of time-interleaved high-pass delta sigma modulator. In *ISCAS 2006*, Kos, Grèce, May 2006.
[374] V. T. Nguyen, H. Petit, P. Loumeau, and J. F. Naviner. High-pass sigma-delta modulator. In *Design, Automation and Test in Europe, DATE*, Nice, France, Apr. 2007.
[375] S. Peychet, P. Desgreys, and C. Ware. Simulation of jitter in an optoelectronic PLL with VHDL-AMS. In *XX Conference on Design of Circuits and Integrated Systems*, Lisboa - Portugal, Nov. 2005.
[376] A. Riaz, J. F. Naviner, and V. T. Nguyen. A novel approach to non‐coherent UWB reception. In *IMTIC'08, International MultiTopic Conference*, Mehran, Pakistan, Apr. 2008.
[377] L. Schreider, X. Begaud, M. Soiron, and B. Perpere. Thickness reduction of unidirectional spiral antennas. In *Antenna technology and applied electromagnetics 2005*, St Malo, June 2005.
[378] L. Schreider, X. Begaud, M. Soiron, and B. Perpere. Design of a broadband archimedean spiral antenna above a thin modified electromagnetic band gap substrate. In *Eucap 2006*, Nice France, Nov. 2006.
[379] I. S. S. Silva, J. F. Naviner, and R. C. S. Freire. Compensation of electrodes impedances mismatch in biopotential measurement. In *MeMeA 2006 - International Workshop on Medical Measurement and Applications*, Benevento, Italie, Apr. 2006.
[380] I. S. S. Silva, J. F. Naviner, and R. C. S. Freire. Cmos integrated circuit for power-line interference reduction in biopotential measurements. In *MeMeA 2006 - International Workshop on Medical Measurement and Applications*, Benevento, Italie, Apr. 2006.
[381] S. Souari, P. Loumeau, M. Loulou, and N. Masmoudi. High order cascade multibit ΣΔ modulators for wide bandwidth applications. In *IEEE International Conference on Electronics, Circuits and Systems*, La Marsa, Tunisie, Dec. 2005.
[382] D. Teixeira Franco, J. F. Naviner, and L. Naviner. Chemins de données robustes pour les systèmes de traitement du signal. In *Journées Nationales du Réseau Doctoral en Microélectronique, JNRDM*, Lille, France, May 2007.
[383] D. Teixeira Franco, J. F. Naviner, and L. Naviner. Convolution blocks based on self-checking operators. In *14th International Conference Mixed Design of Integrated Circuits and Systems - Mixdes*, Ciechocinek, Pologne, June 2007.
[384] A. Thior, A. C. Lepage, and X. Begaud. Low profile, directive and ultra wideband antenna on a high impedance surface. In *Eucap 2009*, Berlin Allemagne, Mar. 2009.
[385] M. Troudi, S. Zouari Krichen, P. Loumeau, M. Loulou, and N. Masmoudi. Conception d'un convertisseur n/a à capacités commutées linéarisé par la méthode dwa. In *Journées Scientifiques des Jeunes Chercheurs rn Génie Electrique et Informatique*, pages 375 – 382, Hammamet, Tunisie, Mar. 2006.
[386] M. Vahdani and X. Begaud. A directive ultra wideband sinuous slot antenna. In *Eucap 2006*, Nice France, Nov. 2006.
[387] M. Vahdani and X. Begaud. Sinuous antenna fed by a microstrip-to-cps balun. In *Eucap 2009*, Berlin Allemagne, Mar. 2009.
[388] V. Y. Vu, A. J. Braga, X. Begaud, and B. Huyart. Direction of arrival and time of arrival measurements using five-port reflectometers and quasi-yagi antennas. In *Antenna Technology and Applied Electromagnetics (ANTEM)*, St Malo, June 2005.
[389] V. Y. Vu, A. J. Braga, X. Begaud, and B. Huyart. Direction of arrival and time delay measurements for multi-path signals using five-port reflectometers. In *2005 IEEE AP-S International Symposium*, Washington DC, July 2005.
[390] V. Y. Vu, A. J. Braga, X. Begaud, and B. Huyart. Narrow band direction of arrival measurements using five-port reflectometers and quasi-yagi antennas. In *European Conference on Propagation and Systems*, Brest - France, Mar. 2005.
[391] V. Y. Vu, A. J. Braga, X. Begaud, and B. Huyart. Joint TOA/DOA measurements for spatio-temporal characteristics

of 2.4 GHz indoor propagation channel. In *European Conference on Wireless Technology 2005*, Paris, Oct. 2005.
[392] J. Zbitou, C. Minot, X. Begaud, and B. Huyart. Bow-tie wideband antenna design for CW Thz photonic transmitters. In *PIERS 2008 in Cambridge*, Cambridge, USA, July 2008.
[393] F. Ziadé, A. Kazemipour, D. Allal, and E. Bergeault. Optimized time-domain simulator for a calculable RF power standard. In *AMCTM VII*, lisbone, June 2005.
[394] F. Ziadé, A. Kazemipour, E. Bergeault, D. Allal, and M. Bourghes. TOWARD A CALCULABLE RF POWER STANDARD. In *Conference on Precision Electromagnetic Measurement s(CPEM)*, Turin, Italie, July 2006.
[395] F. Ziadé, A. Kazemipour, E. Bergeault, D. Allal, and M. Bourghes. Rf power measurement, calculable primary standard. In *Conference on Precision Electromagnetic Measurement (CPEM)*, Broomfield, USA, June 2008.

3.3.3 ACTN: Articles in Proceedings of French Conferences

[396] G. I. Abib, S. Bensmida, E. Bergeault, and B. Huyart. Banc de mesure source-pull / load-pull pour amplificateurs de puissance. In *JNM 2007*, Toulouse, May 2007.
[397] W. Altabban, P. Desgreys, and H. Petit. Implémentation et simulation d'un modèle LTV du bruit de phase dans un VCO. In *TAISA*, Lyon France, Oct. 2007.
[398] M. Bahouche, D. Allal, E. Bergeault, and B. Huyart. évaluation de la technique de calibrage tra (thru reflect attenuator) pour la traçabilité des mesures sous pointes. In *JNM 2007*, Toulouse, May 2007.
[399] X. Begaud. Antenne large bande et métamatériaux. In *Journées d'études SEE - ANTENNES NON STANDARD*, Villebon sur Yvette, Jan. 2009.
[400] S. Bensmida, E. Bergeault, G. I. Abib, and B. Huyart. Banc de caractérisation fonctionnelle de transistor de puissance en présence de signaux modulés. In *Journées Nationales des Micro ondes*, Nantes, May 2005.
[401] A. J. Braga, V. Y. Vu, B. Huyart, and J. C. Cousin. Système de formation de faisceaux utilisant des réflectomètres cinq-port. In *Journées Nationales de Microondes*, Nantes, May 2005.
[402] E. Colin and J. F. Naviner. Spécifications des blocs d'un récepteur à partir des spécification globales : L'exemple de l'UMTS. In *Colloque sur le Traitement Analogique de l'Information, du Signal et ses Applications*, Marseille, France, Oct. 2005.
[403] E. Colin, P. Desgreys, and H. Petit. Simulation d'un Frontal de Réception RF. In *Colloque sur l'Enseignement des Technologies et des Sciences de l'Information et des Systèmes*, Nancy, France, Oct. 2005.
[404] J. C. Cousin. Radar multistatique d'aide à la conduite pour le positionnement 2D de cible à courtes distances par la technique FMCW associée à l'interférométrie. In *JNM 2007*, Toulouse, May 2007.
[405] P. Desgreys, J. Gomes Da Silva, and D. Robert. Impact de la dispersion sur les performances du CNTFET n+-i-n+ balistique. In *Traitement Analogique de l'Information, du Signal et ses Applications*, Strasbourg, France, Oct. 2006.
[406] H. El Arja, B. Huyart, and X. Begaud. Estimation conjointe des retards et des directions d'arrivées dans un canal ulb par la méthode music. In *JNM*, Grenoble France, May 2009.
[407] A. Judson Braga, V. V. Yem, S. Martinez Lopez, B. Huyart, and J. C. Cousin. Mesure des angles d'élévation et d'azimuth utilisant des réflectomètres cinq-port. In *CNFRS-URSI*, Paris, Mar. 2006.
[408] H. A. Khushk, V. T. Nguyen, and P. Loumeau. Novel architecture for high-pass cascaded delta-sigma modulator. In *TAISA 2007*, Lyon, France, Oct. 2007.
[409] A. Latiri, M. Ben Romdhane, P. Desgreys, and P. Loumeau. Impact du bruit de phase sur les performances de l'échantillonnage RF. In *Colloque sur le Traitement Analogique de l'Information, du Signal et ses Applications*, Marseille, France, Oct. 2005.
[410] F. Linot, X. Begaud, M. Soiron, C. Renard, and M. Labeyrie. Caractérisation d'une surface haute impédance chargée par des résistances. In *JNM*, Grenoble France, May 2009.
[411] m. bahouche, E. Bergeault, and D. Allal. Calibrage de l'analyseur de réseau vectoriel sur wafer avec la méthode d'auto-calibrage lar (line attenuator reflect). In *JNM 2009*, Grenoble, May 2009.
[412] K. Mabrouk, B. Huyart, X. Begaud, and A. Belhadjmohamed. Auto-calibrage du récepteur homodyne cinq-port. In *JNM 2007*, Toulouse, May 2007.
[413] S. Martinez Lopez, H. Elarja, B. Huyart, and J. C. Cousin. Sondage de canal haute-résolution utilisant un signal chirp. In *JNM 2007*, Toulouse, May 2007.
[414] C. Mohamed and B. Huyart. Conception d'un récepteur 15 GHz Low IF en technologie MMIC utilisant la technique " 5 port ". In *JNM 2007*, Toulouse, May 2007.
[415] r. mohellebi, S. Manga, H. El Arja, and B. Huyart. Télécommunications sans fils par retournement temporel. In *JNM 2009*, Grenoble, May 2009.
[416] S. Souari, P. Loumeau, M. Loulou, and N. Masmoudi. Modulateur Sigma Delta mash 2-1-1 multi-bits linéarisé par "DWA" pour application radiomobile large bande. In *Colloque sur le Traitement Analogique de l'Information, du Signal et ses Applications*, Marseille, France, Oct. 2005.
[417] V. Y. Vu, A. J. Braga, X. Begaud, and B. Huyart. Estimation des directions d'arrivée et des retards de propagation par utilisation de la technique cinq-port. In *14èmes Journées Nationales Micro-ondes JNM 2005*, Nantes, May 2005.
[418] F. Ziadé, A. Kazemipour, D. Allal, and E. Bergeault. Faisabilité d'un étalon calculable de puissance hf. In *JNM 2005*, Nantes, May 2005.
[419] F. Ziadé, A. Kazemipour, E. Bergeault, M. Bourghes, and D. Allal. Wattmètre en technologie coplanaire, applicartion métrologique. In *JNM 2007*, Toulouse, May 2007.

3.3.4 COM: Talks in Conferences Which Do Not Publish Proceedings

[420] G. I. Abib, S. Bensmida, E. Bergeault, and B. Huyart. Linéarisation d'amplificateurs de puissance dans un environnement. In *Journée des Doctorants, AREMIF*, Paris, Mar. 2007.

3.3.5 AFF: Posters in Conferences

[421] W. Altabban, P. Desgreys, and H. Petit. Modélisation comportementale d'une ADPLL en VHDL-AMS. In *Colloque National du GDR SOC-SIP*, Paris France, June 2007.
[422] W. Altabban, P. Desgreys, and H. Petit. Modèle comportemental de l'adpll en vhdl-ams. In *Colloque National du GDR SoC-SiP*, Paris, France, June 2008.
[423] M. Ben Romdhane, P. Desgreys, P. Loumeau, C. Rebai, K. Grati, and A. Ghazel. Vers les convertisseurs analogiques numériques à echantillonnage non-uniforme. In *Colloque du GRD SoC-SiP*, Paris, France, June 2007.
[424] D. Camarero, K. Ben Kalaia, J. F. Naviner, and P. Loumeau. Mixed-signal clock-skew calibration for time-interleaved analog-to-digital converters. In *Colloque National du GDR SOC-SIP*, Paris, June 2007.
[425] R. Guelaz, P. Desgreys, and P. Loumeau. RSFQ comparator modelling for superconducting sigma-delta bandpass ADC. In *Colloque National du GDR SoC-SiP*, Paris-France, June 2008.
[426] H. A. Khushk, V. T. Nguyen, and P. Loumeau. Novel approach for cascade delta sigma modulator. In *GDR SOC-SIP 2007*, June 2007.
[427] A. Latiri, P. Desgreys, and P. Loumeau. A Reconfigurable GSM-WIFI Radio Receiver Based on RF Sampling. In *Colloque du GDR SoC-SiP*, Paris, France, June 2007.
[428] S. Masmoudi, P. Loumeau, and J. F. Naviner. Mise en oeuvre d'un réseau de capteurs RF. In *Journées Pédagogiques du CNFM*, Saint-Malo, France, Nov. 2006.
[429] A. I. Najam, J. F. Naviner, and V. T. Nguyen. Receiver Architecture for Low Data Rate Ultra-Wideband (UWB) Communications. In *Colloque National du GDR SOC-SIP*, Paris, June 2007.
[430] J. F. R. Negrão, J. F. Naviner, I. S. S. Silva, and R. C. S. Freire. Circuit mixte dinterface reconfigurable pour applications en instrumentation médicale. In *Journées Nationales du Réseau Doctoral de Microélectronique*, Rennes, France, May 2006.
[431] D. Teixeira Franco, J. F. Naviner, and L. Naviner. Architectures reconfigurables pour les systèmes de traitement du signal. In *Colloque National du GDR SOC-SIP*, Paris, June 2007.
[432] D. Teixeira Franco, M. Correia De Vasconcelos, L. Naviner, and J. F. Naviner. Evaluating signal reliability of logic circuits by signal probability. In *Colloque National du GDR SoC-SiP*, Paris, France, June 2008.

3.3.6 OS: Books and Book Chapters

[433] R. Guelaz, P. Desgreys, and P. Loumeau. *Wide-Band Sigma-Delta ADC Design in Superconducting Technology*, chapter 7, pages 101–112. Springer, 2009. To appear.
[434] B. Huyart. *Dispositifs hyperfréquences actifs et passifs, chapitre Dispositifs passifs réciproques*. Ed. Hermes, Collection EGEM, Paris 2006, 2006.
[435] P. Loumeau, L. Naviner, and J. F. Naviner. *La Conversion Analogique-numérique pour la Radio Logicielle*, chapter 7. Hermès, Paris, 2005.
[436] P. Loumeau, L. Naviner, and J. F. Naviner. *Analog-to-digital conversion for software radio*. Iste Publishing Company, GB, 2007.

3.3.7 AP: Other Productions: Database, Registred Software, Registred Patent, . . .

[437] T. Boudet, C. Guichard, B. Huyart, J. C. Cousin, and I. Masri. Détecteur de proximité hyperfréquence. (FR-04-03459), Oct. 2005.
[438] B. Huyart and F. Rangel De Sousa. démodulateur /modulateur par conversion directe de fréquence. (FR 04 10644), Dec. 2005.
[439] A. Khy and B. Huyart. Conhrad. Technical Report CPV711, 2008.
[440] P. Loumeau, V. T. Nguyen, D. Camarero, and A. Latiri. Dispositif et procédé de traitement du signal utilisant plusieurs voies en parallèle. (FR 08/54846), July 2008.
[441] K. Mabrouk and B. Huyart. Dispositif analogique pour la calibration des récepteurs zéro-if cinq-port et triphasé. (FR: 08/04460), July 2008.
[442] I. Masri, T. Boudet, J. C. Cousin, A. Guillot, and B. Huyart. Méthode de détection hyperfréquence et détecteur utilisant cette méthode. (FR 06 50462), Aug. 2007.
[443] C. Mohamed. *Conception d'un circuit démodulateur direct de signaux R.F. dans la bande de fréquence 1-24 GHz*. PhD thesis, Ecole Nationale Supérieure des Télécommunications, Apr. 2008.
[444] J. F. Naviner. Architectures radiofréquences pour l'émission de signaux impulsionnels à ultra large bande- etat de l'art. Technical Report 46 131 221, École Nationale Supérieure des Télécommunications, Apr. 2007.

[445] J. F. Naviner. Contribution à la recherche en microélectronique analogique et numérique : Cao, circuits et architectures reconfigurables. Technical report, Université Pierre et Marie Curie, Nov. 2008.
[446] V. T. Nguyen, D. Camarero, P. Loumeau, and J. F. Naviner. Sigma-delta avec l'entrelacement temporel. Technical Report 2K CPR606, Ecole Nationale Supérieure des Télécommunications, Sept. 2006.
[447] V. T. Nguyen, P. Loumeau, and P. Benabes. Convertisseur sigma-delta. (FR 08/53213), May 2008.
[448] V. T. Nguyen, P. Loumeau, and H. Fakhoury. Convertisseur sigma-delta. (FR 08/58632), Dec. 2008.
[449] H. Petit. logiciel PLLXPLORE, 2008.
[450] L. Schreider, M. Soiron, B. Perpere, and x. begaud. Dispositif de structure à bande interdite électromagnétique et dispositif d'émission et de réception d'ondes électromagnétiques. (FR 05 11966), Dec. 2005.
[451] M. Vahdani. *Low-profile, Ultra Wideband and Dual Polarized Antennas and Feeding Systems*. PhD thesis, TELECOM ParisTech, Oct. 2008.
[452] x. Begaud. Contribution à la recherche d'un système antennaire pour la radio logicielle. Technical report, Université Pierre et Marie Curie, June 2007.

Chapter 4

Optical Telecommunications Group (GTO)

Team leader Didier Erasme (P).

Faculty

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Faculty IT	6
PhD students	13.8
Post-docs, engineers and sabbaticals	1.5
Defended PhD theses	22
Journal papers [published, in press]	[65, 8]
Papers in conference proceedings	101
Chapters and books	1
Patents	2
Grants [public, private, european] (k€)	[808, 512, 120]

4.1 Objectives

The evolution of optical communication systems represents a particularly challenging guideline for research activities taking place in the GTO group of Télécom ParisTech. In addition to the topics directly relevant to the upgrading of optical networking techniques, architectures, devices, components, etc., our field of activity expands both to subjects that use similar methods and technologies and to characterization systems for telecommunication devices.

The last four years have represented an important transition period for the field of optical communications. In the early 2000s, the strong development of the “copper” access techniques (ADSL, Cable) and the remaining overcapacity of metro and core optical network opened a new development window for the next technology step strongly relying on optical technology: The transition of the fixed access network onto an optical medium (FTTH), convergence techniques for carrying mobile communication signals over optical fibre (RoF), access-metro convergence and finally the new requirement for capacity and connectivity in the metro and core networks due to the explosion of the data exchanges for domestic (HDTV, VoD, P2P) and professional (data storage) applications. Presently, the three traditional fixed-network segments are all going through a strong evolution process:

- with the deployment of FTTH (Fibre-to-the-home) the optical access network has had to enter the industrial world with some rather traditional solution while more advanced solutions which would better take advantage of optical technology are still under strong competitive development (WDM PON, OCDMA, ...)
- the metropolitan network has to cope with an enhanced connectivity and some constraints related to equipment cost which requires new technical solutions;
- in order to cope with the increase in the capacity demand, the core network is migrating toward higher individual channel bit-rates up to 40 Gbit/s (leading to new transmission impairments) in a rather traditional way. However, it is now quite clear that further evolution, which requires a better usage of the fiber optics bandwidth, has to rely on new paradigms. These are bound to make use of the somehow under-considered knowledge in digital communication that has been the key development tool of RF mobile communication.

In this wide panorama, the GTO group relies on its theoretical competence and its modeling and experimental know-how for developing new concepts and for participating in advanced collaborative research on optical systems.

A first research axis concerns the development of new optical signal processing techniques and functional analysis of new components for communication systems. This field covers several

related studies gravitating around non-linear optical effects and behaviors concerning light emission, light amplification, light transmission and new reception techniques. Although a number of applications lie in the field of telecommunication, the activity expands to other application areas such as energy, industrial process and defense.

The second research axis lies closer to the actual networks and transmission systems structures, approaching multiplexing techniques, high bit rate communication, new optical network architectural topics.

Finally, a specific research axis is related to quantum communications in particular to quantum key distribution for cryptography systems.

These research axes usually associate theoretical investigation and modelling activities, simulation using internal or commercial software and experimental activities. The latter rely on a rather well-equiped optical laboratory which includes a 10Gbit/s transmission platform, picosecond optical facilities allowing some 40Gbit/s experiments and dedicated characterisation and sensor set-ups.

The reporting period has been characterized by many national initiative interactions, (ANR, Cifre) and an enhanced activity on the European landscape. Through FP6-e-Photon/ONe$^+$ and FP7-BONE and FP7-EURO-FOS Networks of Excellence our international activity has been pushed to a high level. In addition to project review papers involving many teams, we can count journal publications with laboratories representing as many as 7 different countries (Denmark, Japan, USA, UK, Mexico, China, Greece).

4.2 Main Results

The main research results obtained during the period 2005-2009 are presented below for the research areas of the GTO team.

4.2.1 Optical Functionalities and Novel Devices for Communication Systems and Networks

Faculty G. Debarge, D. Erasme, R. Gabet, P. Gallion, Y. Jaouën, C. Ware.

Projects RNRT-ROTOR (01/04–12/07), Pôle System@tic-CARRIOCAS (10/06–09/09), ANR AROME (01/07–12/09), ANR L2CP, FP7-EUROFOS (05/08–04/12), trilateral projet with EDF and LCPC, Bilateral project with ONERA and with CEA, 2 cifre PhD.

The widespread introduction of broadband at all levels of communication networks, the ubiquity of data exchange, the wired network infrastructure increasingly using the optical medium, and its being extended over the last mile all the way to the end-users, are changing the deal on signal processing functions implemented directly in the optical domain, giving them a foremost place in system design. These *optical functionalities* aim at keeping, as best can be done, the optical signal's integrity, avoiding optical-to-electrical conversions. The intrinsically high speed of the physical phenomena to be used allows them to take over processes which were traditionally implemented in the electrical domain, and the development of devices adapted to these applications.

Clock Recovery

Clock recovery of a high-bit-rate digital signal (10, 40, 160 Gbit/s) is a required functionality at transmission end or in a routing node. Two techniques have been studied: self-pulsating lasers and opto-electronic phase-locked loops.

On the former, the ROTOR RNRT project[1] to point out the interest in quantum dot lasers structures for optical engineering and radio frequency signals in general has demonstrated ultra

[1] Partners: CNRS LPN Laboratory, Alcatel Thales III-V Lab, Alcatel Lucent, ENSSAT, EUROPTEST, Highwave

low self-pulsating line width and the superiority of all-optical techniques over the electrical ones for clock recovery at 43 Gbit/s [638, 499, 500].

Second, a phase locked-loop can use a nonlinear optical device (SOA or PPLN) as an ultra-fast phase comparator. It allows clock recovery of RZ signals—and NRZ in some cases—as well as OTDM demultiplexing by recovering the "sub-clocks". Collaborating with the Technical University of Denmark and the National Institute for Materials Sciences of Japan, we demonstrated sub-clock recovery [513] and full 1/64 OTDM demultiplexing at 640 Gbit/s. [469]. This was the second-ever demonstration of clock recovery at that high a bit rate, and the first involving a PPLN device, which was announced among record-setting postdeadline papers in OFC'2008.

This activity, in the framework of e-Photon/ONe$^+$ and now EURO-FOS[2], was rewarded by an invited paper in the Journal of Lightwave Technology [490] and the "Letter of the Month" of Electronics Letters. It is now part of the topic of a franco-german PICF grant application and a Joint Experimental Activity in EURO-FOS.

New Semiconductor Sources and Devices

The recent evolution of the optical communication network led to a large demand for new low-cost and high-performance components. The CARRIOCAS project[3] is dedicated to setting up an experimental 40Gbit/s network for high capacity data exchanges, included a task related to the development of low cost front end optical sources. In collaboration with GIE Alcatel-Thales III-V lab, we were able to demonstrate how "dual modulation", consisting in modulating simultaneous the laser and the modulator of an EML source, leads to an extended transmission span (from 80 to 160 km) at 10Gbit/s [547]. Our involvment in the ANR project AROME[4] is dedicated to the evaluation of the very large spectral bandwitdth semiconductor optical amplifiers fabricated in GIE Alcatel-Thales III-V lab. The group is involved in other devices development through 2 new Cifre theses with III-V lab (on 100G receivers and reflective SOA modules for access networks).

Distributed Amplification

The distributed amplification based on the Raman effect, appears as an alternative or an additional technique to the doped fiber amplifier for optical telecommunications. However noise transfer from the pump noise to the signal, the pump polarization fluctuation and the double Rayleigh scattering strongly impact the noise figure [455, 479, 521, 539] and constrain their use. A new mechanism of noise associated with the fluctuation of the pump polarization induced by spatial fluctuation of the birefringence has been identified and allows interpretation of experimental reports [477]. As for the Brillouin effect, when it does not limit the power injected into a fiber, it is an irreplaceable tool in the design of optical sensors [522].

Brillouin Effect Applications

Given its low required power threshold, the Brillouin effect in optical fiber is one of the most promising nonlinear effect to design new all-optical processing. A self-referenced technique for measuring the Brillouin gain in an optical fiber has been recently proposed; and the importance of acousto-optic effective area in place of optical effective area on the Brillouin efficiency has been

[2] Partners: Institute of Communication & Computer Systems/ National Technical University of Athens (leader), Heinrich-Hertz Institute, University of Essex, Universitat Politecnica de Catalunya, ACREO AB, Technical University of Eindhoven, Research and Educational Laboratory in Information Technology, Chalmers University of Technology, University of Karlsruhe, Politechnico di Torino, University College Cork, Scuola Superiore Sant'Anna, Universidad Polytecnica de Valencia, Interuniversitair Micro-Elektronica Centrum IMEC, Instituto de Telecomunicaoes, Technical University of Denmark

[3] Partners: Bull, CGG-Veritas, Draka Comteq, EDF, France Telecom, GIE Alcatel Thales III-V lab, Hewlett Packard, Renault, Kylia, Medit, N2Nsoft, Oxalya, CEA, CNRS, Ecole centrale de Paris, IEF (université Paris-Sud 11), INRIA, Marben products, Prism (Université de Versailles Saint-Quentin), Supélec, Telecom et Management SudParis

[4] Partners: Alcatel Thales III-V Lab (leader), FTR&D, ENIB, INSA Toulouse, IEMN

confirmed for the first time [484]. The slow-light concept has been changed from a scientific curiosity to a rapidly growing field with many potential applications. We have demonstrated simultaneous demodulation and slow-light delay of DPSK signals at flexible bit rates using Brillouin based optical filtering effect. A record delay-time of 81.5ps with error-free operation (BER$< 10^{-9}$) has been obtained for 10Gb/s [518]. The delay and BER performance of 10Gb/s signal in Brillouin-based slow-light delay line have been evaluated in terms of NRZ, PSBT and DPSK modulations formats [517]. The distributed Brillouin-based optical sensors appear to be one of the most promising techniques for temperature and strain measurement. Under a collaboration with EDF, our contribution is focused on fiber design, especially in terms of Brillouin spectrum [541].

High-Power Fiber Lasers

The technology of rare-earths doped optical fibers (Ytterbium (Yb^{3+}) for amplification at 1µm and Erbium/Ytterbium (Er^{3+}/Yb^{3+}) at 1.55µm) represents a strong contender for applications requiring high optical power. Our contribution is carried out mainly through collaborations with external laboratories and companies: ONERA, Keopsys and CEA [475, 537], PhLAM laboratory of University of Lille. With ONERA we have participated in the design of LMA fiber amplifiers [458, 460], in the analysis of Brillouin spectrum of doped fibers in connection with doping [459], and more recently the combination of coherent fiber amplifiers [481, 565]. The collaboration with PhLAM concerns the design of Ytterbium-doped solid core photonic bandgap fiber laser operating around 980nm [495].

Optical Low Coherence Reflectometry

The optical low-coherence reflectometer (OLCR) developed in our laboratory has been upgraded over the years and has proven to be a unique investigation tool for the study and the characterization of new photonic components. Through collaboration with component makers, we have been able to measure some otherwise inaccessible parameters in optical wavelength mux-demux, speciality optical fibers, fiber Bragg gratings, semiconductor devices, including semiconductor optical amplifiers... Our state-of-the-art phase-sensitive OLCR spatially resolves internal reflections of the device under test, and allows measurement of different polynomial terms of dispersion, birefringence, loss / gain material coefficient, phase/amplitude coupling coefficients. It has attracted many national and international collaborations, industrial and academic. The latest results concern the study of photonic bandgap semiconductor waveguides under the ANR-L2CP[5] project [461, 492, 536, 546] in collaboration with Thalès R&T and specialty fibers characterization [467, 474] for which the OLCR provides incomparable elements of analysis.

4.2.2 Optical Network Evolutions

Faculty D. Erasme, P. Gallion, Y. Jaouën, C. Ware.

Projects ANR-Supercode (10/06–11/09), ANR-TCHATER (10/07–12/10), FP6-e-Photon/ONe$^+$, FP7-BONE (1/08–12/10), FP7-EUROFOS (05/08–04/12), research project Orange labs, 3 Cifre PhD.

Fast development of bandwidth-consuming services like high-definition/on-demand television, network gaming, grid computing, makes stringent the need to further network capacity. The objective to provide broadband to a maximum of users (“broadband-for-all”) has been leading research and development in the field of fibre-to-the-home (FTTH) technology for the deployment of high bit-rate access networks. The optical networks must manage interfaces with the copper links and radio access technologies (fixed or mobile) or eventually replace other solutions to provide unmatched performances. Deployment of FTTH will significantly impact the capacity requirement

[5] Partners: Thales R&T (leader), CNRS/LPN, IEMN

carried by metro and core transport networks in a medium-term future. The fiber capacity must also be maximized through the deployment of new techniques such as new multi-level modulation formats eventually combined with coherent detection, new techniques for multiplexing and routing (packet switching).

Optical Access and Code-Division Multiple Access

Wide adoption of optical access network requires upgrading existing PONs to share bandwidth among more users. An important access to research in PON architecture and components exists through collaboration and Cifre Thesis with FT-Orange labs on new generation PON including extended PON, WDM PON, etc.

On the other hand, we have developed a research activity on a more prospective access network possible evolution namely OCDMA multiplexing techniques. CDMA (Code Division Multiple Access) in the optical access networks allows scrambling and a flexible bandwidth resource sharing between users. For the direct optical detection channel, we have pointed out that the prime sequences (PS) appear as a good compromise between the length and the weight of the code and the number of users [464] Implementation of all-optical encoders and decoders using Bragg gratings recorded in photo-optical fibers (made in collaboration with the laboratory PhLAM of the University of Lille) has been analyzed for different code structures [466].

Additionnally, the ANR-SUPERCODE[6] project combines WDM and OCDMA by designing a supercontinuum pulsed source which can be shared among many users by being sliced into WDM channels [586, 597], each of which supports multiple users through all-optical encoding and decoding. This last work has started building on direct-sequence codes (DS-OCDMA), now with the extended quadratic congruence (EQC) code family for better multiuser performance.

However, this is still an amplitude-only coding scheme; as in the long-haul context, using the phase of the optical field would unlock the full bandwidth of the optical fiber, if it can be done in a cost-effective way for the access network. This is SUPERCODE's final objective: using spectral-phase coding thanks to enhanced FBG-based encoders using phase-shifted chirped Bragg gratings. This technique, which could either complement or even supersede WDM, should yield a much lower crosstalk between users on the same channel, thus supporting more users for a lower penalty.

Radio-Over-Fiber

The interface between the radio and optical fiber networks (radio-on-fiber), remote antennas for radar, introduce new challenges for fiber optic transmissions, which should preserve the dynamics and the linearity of the signal even in the presence of attenuation, GVD and PMD dispersion, non linearity transmission impairments and all optical signal processing. An original approach based on optical injection allows the heterodyne generation, transmission and remote control of radio frequency signals with high spectral quality [462, 635]. A generalization on injection locking optical phase synchronization has been proposed by using the Green function approach [482, 642, 580].

Metropolitan and Long-Haul Systems

Today's processing capability allows to perform digital signal processing for optical communication systems at high bit rates. In close collaboration with the Digital Communications group, the potential and future trends of electrical signal processing techniques to mitigate e.g. noise accumulation, linear and nonlinear distortions are beginning to be investigated.

Under the project ANR-ECOFRAME[7] we have modeled and simulated the physical channel of an optical ring WDM network architecture. We provide the parameters of the statistical distribution

[6] Partners: Institut Carnot de Bourgogne (leader), CNRS PhLAM, XLIM
[7] Partners: Alcatel, Orange, Prism Laboratories, XLIM

χ^2 and estimate the performance in collaboration with XLIM working on FEC implementation [528, 501]. An extension of the concept to mesh networks has been proposed.

On the other hand, the project ANR-TCHATER[8] concerns the design of a real-time coherent receiver at 40Gbit/s using a FPGA implementation. Our contribution concerns the design of hard and soft FEC solutions adapted to optical coherent systems. Differential encoding is required for PSK transmission systems but leads to higher BER because each transmission error corrupts multiple consecutive bits. A new construction of the codeword has been proposed, allowing performance enhancement and complexity decrease [544, 645].

Finally, we have begun to explore higher spectral efficiency modulation formats, such as M-QAM and OFDM, that can allow enhanced bit-rate while reducing electronic circuits speed [551]. In collaboration with Orange labs, a comparison of 40Gb/s ultra-long haul WDM transmission system performances has been realized [493, 494].

Optical Packet Switching

The evolution of optical networks toward more efficient and more flexible architectures has led research work to wonder how the network could transmit and route optical packets or optical bursts directly on the optical layer. Studying the routing of optical packets requires an analysis of techniques allowing label recognition and transparent packet forwarding. On the basis of our knowledge of all-optical signal processing devices, we have developed several elements required for the design of a switching node, including an optical half-adder [502], a time-to-wavelength (series-to-parallel) converter [503] and an all-optical decoder [504]. Finally, in collaboration with partners teams of the FP6-ePhoton/One NoE, we have proposed an entire packet-switching node whose optical elements had all been demonstrated experimentally by one of the participating groups [505].

4.2.3 Quantum Communications and Cryptography

Faculty P. Gallion.

Main events Organisation of the CLEO Focus Meeting on “Nonlinear, Quantum and Chaotic Optics: New Directions in Photonics and Optical Communications” in ECOC’06 conference.

Projects ANR-HQNet (12/06–11/09).

Quantum key distribution (QKD) is the only known way to achieve cryptographic keys distribution with unconditional security. Quantum security first results from the impossibility to duplicate the signals received (non-cloning principle) or to take away a significant part of the signal without making the intervention known through a major change to the error rate of received signals. The security is based secondly on the disturbing or destroying character of any observation and the errors resulting from incompatible observations of a single quantum object.

Quantum cryptography is today leaving the promises of the physics of the last century for the trial implementations. The unconditional security range is obviously limited by optical channel and device impairments. Quantum cryptography must now prove its worth with the technological reality and deal with the algorithms and hardware securities, in a rich multi discipline problem including digital communications, optical communications, information theory, electronics signal processing and computing. In collaboration with our Electronics group and the Computer Science Department we have developed a validation platform for quantum cryptography gathering these various skills and involved in various projects such as the “High bit-rate and versatile Quantum Network” (ANR-HQNETfootnotePartners: FEMTO, Georgia Tech Lorraine, Smart Quantum, Photline) including also efforts from the FEMTO Laboratory of Besançon, the Georgia Tech Lorraine Laboratory and Smart Quantum and Photline companies.

[8] Partners: Alcatel-Lucent France (Leader), E2V semiconductors, INRIA Lyon, ENS Lyon

The compatibility of QKD with optical networks requires an operation at telecommunication wavelengths and does not allows polarization encoding. We proposed and validated the use of a QPSK phase modulation, turning to PSK signals after the Bob choice of basis, in association with a homodyne optical detection. As long as single-photon sources remain unavailable, we have to deal with non-orthogonal signals from quantum level coherent fainted pulses. We conducted the theoretical and experimental comparison of a balanced homodyne receiver with a high local oscillator level using PIN photodiodes with an unconditionally hypothesis-canceling interferometrical receiver on one of 2 photon counters [515]. Our homodyne receiver appears as a good alternative to the photon counters technique in view of its closeness to a quantum efficiency of 1, its thermal-effect-free operation and speed compatible with the key rate required by today applications. An intrinsic error rate resulting from the vacuum fluctuations entering through the signal port leads to a theoretical quantum bit error rate (QBER) which is approached quite easily in practice, the standard quantum limit (SQL). The use of a multiple-threshold decision allows for the optimization of the quality and the rate of the key generation. The mandatory recovery of both optical and data phases is provided by a time-multiplexed reference signal transmission and phase-tracking loop. We have shown the possibility of recovering the phase with performances very close to the quantum limit by sequential steps on both quadratures of the field received [514] and undertaken the study of security under different types of attack.

We have been among the first contributors to the apparition of quantum cryptography in IEEE optical communication journals and world largest conferences [526, 555, 557, 556, 487]. Finally, we have been invited by Emil Wolf to write a review chapter in the prestigious series “Progress in Optics” [640] and we have proposed a new general formulation for the Quantum macroscopic nonlinear optics [478].

4.3 References

4.3.1 ACL: Articles in ISI-Indexed Journals

[453] D. Armand, Y. Todorov, F. Garet, C. Minot, and J. L. Coutaz. Study of the transmission of subwavelength metallic grids in the tHz frequency range. *IEEE Journal of Selected Topics in Quantum Electronics*, 14(2):513–520, Apr. 2008.

[454] B. Bennai, L. Lombard, V. Jolivet, C. Delezoide, E. Pourtal, P. Bourdon, G. Canat, O. Vasseur, and Y. Jaouën. Brightness scaling based on 1.55µm fiber amplifiers coherent combining. *Fibers and Integrated Optics*, July 2008.

[455] B. Bristiel, S. Jiang, P. Gallion, and E. Pincemin. New model of noise figure and RIN transfer in fiber Raman amplifiers. *IEEE Photonics Technology Letters*, 18(8):980–982, Apr. 2006.

[456] G. Canat, J.-C. Mollier, and Y. Jaouën. Evidence of thermal effects in a high-power er3+-yb3+ fiber laser. *Optics letters*, 30(22):3030–3032, Nov. 2005.

[457] G. Canat, G. Williams, Y. Jaouën, J.-C. Mollier, B. Cole, L. Goldberg, G. Kulscar, and J. P. Bouzinac. Dynamics of high power erbium-ytterbium amplifiers. *Journal of Optical Society of America B*, 22(11):2308–2318, Nov. 2005.

[458] G. Canat, Y. Jaouën, and J.-C. Mollier. Performances and limitations of high brightness Er3+-Yb3+ fibers sources. *Comptes Rendus Physique de l'Académie des Sciences*, 7(2):177–186, Mar. 2006.

[459] G. Canat, A. Durecu, G. Lesueur, L. Lombard, P. Bourdon, V. Jolivet, and Y. Jaouën. Structure of the Brillouin spectra in Erbium-Ytterbium fiber. *Optics Express*, 16:3212–3222, Feb. 2008.

[460] G. Canat, L. Lombard, A. Dolfi, B. Augere, C. Besson, Y. Jaouën, S. Jetschke, S. Unger, E. Gueorguiev, and C. Vitre. High brightness 1.5µm pulsed fibre laser for lidar: from fibres to systems. *Fibers and Integrated Optics*, July 2008.

[461] S. Combrié, N. V. Q. Tran, E. Weidner, A. De Rossi, S. Cassette, P. Hamel, Y. Jaouën, R. Gabet, and A. Talneau. Investigation of group delay, loss and disorder in a photonic crystal waveguide by low-coherence reflectometry. *Applied Physics Letters*, 90:231104, June 2007.

[462] F. Dross, F. Van Dijk, and P. Gallion. Improvement of opto-RF link properties by using a cascade laser source. *IET Optoelectronics, (formely IEE Proc. part J, Optoelectronics)*, 1(1):1–15, Feb. 2007.

[463] J. Fatome, S. Pitois, P. Tchofo Dinda, D. Erasme, and G. Millot. Comparison of conventional and dense dispersion managed systems for 160 Gb/s transmissions. *Optics Communications*, 260(2):548–553, Apr. 2006.

[464] I. Fsaifes, C. Lepers, A.-F. Obaton, and P. Gallion. DS-OCDMA encoder/decoder performance analysis using optical low coherence reflectometry. *IEEE/OSA Journal of Lightwave Technology*, Vol 24(6):3121–3128, Aug. 2006.

[465] I. Fsaifes, C. Lepers, M. Lourdiane, P. Gallion, V. Beugin, and P. Guignard. Source coherence impairments in a direct detection direct sequence optical-code division multiple-access system. *Applied Optics*, 46(4):456–462, Feb. 2007.

[466] I. Fsaifes, C. Lepers, R. Gabet, M. Douay, and P. Gallion. Performance analysis of quadratic congruence codes using superstructured fiber bragg gratings for a flexible data rate coherent ds-ocdma system. *Journal of Optical Networking*, 7(7):692–703, July 2008.

[467] R. Gabet, P. Hamel, Y. Jaouën, A.-F. Obaton, V. Lanticq, and G. Debarge. Versatile characterization of specialty fibres using phase-sensitive olcr technique. *Lightwave Technology*, Mar. 2009.

[468] F. Gómez Agis, C. Ware, D. Erasme, R. Ricken, V. Quiring, and W. Sohler. 10-GHz Clock Recovery Using an Optoelectronic Phase-Locked Loop Based on Three-Wave Mixing in Periodically Poled Lithium Niobate. *IEEE Photonics Technology Letters*, 18(13):1460 – 1462, July 2006.

[469] F. Gómez Agis, L. K. Oxenløwe, S. Kurimura, C. Ware, H. C. Hansen Mulvad, M. Galili, and D. Erasme. Ultra-fast phase comparator for optoelectronic clock recovery PLL-based systems. *Journal of Lightwave Technology*, 27(13): 2439–2448, July 2009.

[470] S. K. Goudos, Z. D. Zaharis, P. I. Lazaridis, and P. Gallion. Optimization of integrated circuits placement for electric field reduction inside telecommunications equipment using Monte Carlo Simulation and Parallel Recombinative Simulated Annealing. *Microwave and Optical Technology Letters*, 49(12):3049–3055, Dec. 2007.

[471] S. K. Goudos, Z. D. Zaharis, M. Salazar-Lechuga, P. I. Lazaridis, and P. B. Gallion. Dielectric Filter Optimal Design Suitable for Microwave Communications by Using Multi-Objective Evolutionary Algorithms. *Microwave and Optical Technology Letters,*, 49(9):2324–2329, Oct. 2007.

[472] A. Guernache, V. Voiriot, D. Locatelli, F. Legrand, R. M. Capella, P. Gallion, and J. Jaquet. Experimental demonstration of spatial hole burning reduction leading to 1480-nm pump lasers output power improvement. *IEEE Photonics Technology Letters*, 17(10):2023–25, Oct. 2005.

[473] A. Guernache, V. Voiriot, F. Legrand, R. M. Capella, P. Gallion, and J. Jaquet. New Design Rules and Experimental Study of Slightly Flared 1480-nm Pump Lasers. *IEEE Photonics Technology Letters*, 18(6):792, Mar. 2006.

[474] P. Hamel, Y. Jaouën, R. Gabet, and S. Ramachandran. Optical low coherence reflectometry for complete chromatic dispersion characterization of few-mode fibers. *Optics Letters*, 32(9):1029–1031, May 2007.

[475] S. Hocquet, D. Penninckx, E. Bordenave, C. Gouédard, and Y. Jaouën. Fm-to-am conversion in high-power lasers. *Applied Optics*, 47(18):3338–3349, June 2008.

[476] Y. Jaouën, G. Canat, and S. Grot. Power limitations induced by nonlinear effects in high power fiber amplifiers. *Comptes Rendus Physique de l'Académie des Sciences*, 7(2):163–169, Mar. 2006.

[477] S. Jiang and P. Gallion. Theoretical analysis on the pmd-assisted pump-to-signal noise transfer in distributed fiber raman amplifiers. *IEEE Journal of Lightwave Technology*, 25(10):3185 – 3192,, Oct. 2007.

[478] S. Jiang and P. Gallion. A general formulation for the quantum macroscopic nonlinear optics. *Journal of the Optical Society of America JOSA B*, 26(5):902–909, May 2009.

[479] S. Jiang, B. Bristiel, Y. Jaouën, P. Gallion, and E. Pincemin. Bit-Error Rate Evaluation of the Distributed Raman Amplifiers Based Transmission Systems with the Double Rayleigh Backscattering Noise. *IEEE Photonics Technology Letters*, 19(7), Apr. 2007.

[480] S. Jiang, B. Bristiel, Y. Jaouën, P. Gallion, and E. Pincemin. Full characterization of modern transmission fibers for Raman amplified-based communication systems. *Optics Express*, 19(4):468–470, Apr. 2007.

[481] V. Jolivet, P. Bourdon, B. Bennai, L. Lombard, D. Goular, E. Pourtal, G. Canat, Y. Jaouën, P. Moreau, and O. Vasseur. Wavefront shaping and coherent combining of fiber amplifiers through atmmospheric turbulences. *J. Selected Topics in Quantum Electronics*, 15(2):257–268, Mar. 2009.

[482] F. Kefelian and P. Gallion. Locking and quantum noise properties of multisection semiconductor lasers with opical injection. application to fabry-perot and dfb cavities. *IEEE J. Quantum Electron.*, Vol. 44-6:pp.547–560, June 2008.

[483] F. Kefelian, R. Gabet, and P. Gallion. Characteristics of the phase noise correlation of injection locked lasers for RF signal generation and transmission. *Optical and Quantum Electronics*, 38(4-6):467–478, Mar. 2006.

[484] V. Lanticq, S. Jiang, R. Gabet, Y. Jaouën, F. Taillade, G. Moreau, and G. P. Agrawal. Self-referenced and single-ended method to measure Brillouin gain in monomode optical fibers. *Optics Letters*, 34(7):1018–1020, Apr. 2009.

[485] P. Lazaridis, G. Debarge, P. Gallion, Z. Zaharis, D. Kampitaki, A. Hatzigaidas, A. Papastergiou, and G. Grammatikopoulos. Comparative study of the discrete cosine transform and the discrete orthogonal Gauss-Hermite transform for biomedical signal compression. *WSEAS Transactions on Information Science and Applications*, 3 (11):2264–2269, Nov. 2006.

[486] C. Minot. Golden rules for coherent transport relaxation rates in semiconductor superlattices in the field-induced localization regime. *Physica Status Solidi (c)*, 4(2):347–349, 2007.

[487] H. S. Mousavi and P. Gallion. Decoy state quantum key distribution using homodyne detection. *Phys. Rev. A*, 80 (1):012327–1–4, July 2009.

[488] A.-F. Obaton, C. Palavicini, Y. Jaouën, E. Kerrinckx, Y. Quiquempois, and M. Lievre. Characterization of Fiber Bragg Gratings by Phase-Sensitive Optical Low-Coherence Reflectometry. *IEEE Transactions on Instrumentation and Measurement*, 55(5):1696–1703, Oct. 2006.

[489] L. K. Oxenløwe, F. Gómez Agis, C. Ware, S. Kurimura, H. C. H. Mulvad, M. Galili, K. Kitamura, H. Nakajima, J. Ichikawa, D. Erasme, A. T. Clausen, and P. Jeppesen. 640 gbit/s clock recovery using periodically poled lithium niobate. *Electronics Letters*, 44(5):370–371, Feb. 2008.

[490] L. K. Oxenløwe, F. Gómez Agis, C. Ware, S. Kurimura, H. C. Hansen Mulvad, M. Galili, K. Kitamura, H. Nakajima, J. Ichikawa, D. Erasme, A. T. Clausen, and P. Jeppesen. 640 Gbit/s data transmission and clock recovery using an ultra-fast periodically poled Lithium Niobate device. *Journal of Lightwave Technology*, 27(3):205–213, Feb. 2009. Invited paper.

[491] C. Palavicini, Y. Jaouën, G. Debarge, E. Kerrinckx, Y. Quiquempois, M. Douay, C. Lepers, A.-F. Obaton, and G. Melin. Phase-sensitive optical low-coherence reflectometry technique applied to the characterization of photonic crystal fiber properties. *Optics Letters*, 30(4):361–363, Feb. 2005.

[492] A. Parini, P. Hamel, A. De Rossi, S. Combrié, N. V. Q. Tran, Y. Gottesman, R. Gabet, A. Talneau, Y. Jaouën, and G. Vadala. Time-wavelength reflectance maps of photonic crystal waveguides: a new on disorder-induced scattering. *J. Lightwave Technology*, 26(23):3794–3802, Dec. 2008.

[493] E. Pincemin, A. Tan, A. Tonello, S. Wabnitz, J. D. Ania-Castanon, V. Mezentsev, S. K. Turitsyn, Y. Jaouën, and L. Gruner-Nielsen. Performance comparison of 40 Gb/s ULH transmissions using CSRZ-ASK or CSRZ-DPSK modulation formats on UltraWave fiber. *Optics Express*, 15:11142–11153, Sept. 2007.

[494] E. Pincemin, A. Tan, A. Tonello, S. Wabnitz, J. D. Ania-Castanon, V. Mezentsev, S. K. Turitsyn, Y. Jaouën, and L. Gruner-Nielsen. Performance comparison of SSMF and UltraWaveTM fibers for ultra-long haul 40-Gb/s WDM transmission. *IEEE Photonics Technology Letters*, 19(10):1613–1615, Oct. 2007.

[495] V. Pureur, L. Bigot, G. Bouwmans, Y. Quiquempois, M. Douay, and Y. Jaouën. Ytterbium-doped solid core photonics bandgap fibre for laser operation around 980nm. *Applied Physic Lettes*, 92:061113, Feb. 2008.

[496] J. Renaudier, R. Brenot, B. Dagens, F. Lelarge, B. Rousseau, F. Poingt, O. Le Gouezigou, F. Pommereau, A. Accard, P. Gallion, and G. H. Duan. 45 GHz self-pulsation with narrow linewidth in quantum dots fabry-perot semiconductor lasers at 1.5-µm. *Electronics Letters*, 41(18):1007–1008, Sept. 2005.

[497] J. Renaudier, G. H. Duan, J.-G. Provost, H. Debregeas-Sillard, and P. Gallion. Phase correlation between longitudinal modes in semiconductor self-pulsating DBR lasers. *IEEE Photonics Technology Letters*, 17(04):741–743, Apr. 2005.

[498] J. Renaudier, G. H. Duan, P. Landais, and P. Gallion. Study of phase noise properties and timing jitter of 40 ghz all-optical clock recovery using self-pulsating semiconductor lasers. *IEEE/OSA Journal of Lightwave Technology*, 24(10):3734 – 3742, Oct. 2006.

[499] J. Renaudier, B. Lavigne, F. Lelarge, M. Jourdran, B. Dagens, O. Le Gouezigou, P. Gallion, and G. H. Duan. Standard-Compliant Jitter Transfer Function of All-optical Clock Recovery at 40 GHz Based on a Quantum-Dot Self-Pulsating Semiconductor Laser. *IEEE Photonics Technology Letters*, 18(11):1249–1251, June 2006.

[500] J. Renaudier, G. H. Duan, P. Landais, and P. Gallion. Phase Correlation and Linewidth Reduction of 40 GHz Self-Pulsation in Distributed Bragg Reflector Semiconductor Lasers. *IEEE J. Quantum Electron., Vol 43 -2, pp.147-156 , Feb. 2007.*, 43(2):47–156, Feb. 2007.

[501] S. Sahuguede, D. Fafchamps, A. Julien-Vergonjanne, G. Rodriguez, J.-P. Cances, and P. Gallion. Ldpc code design and performance analysis on ook chi-square based optical channels. *IEEE PhotonicsTechnology Letters*, 2009. To appear.

[502] H. Teimoori, J. D. Topomondzo, C. Ware, H. Soto, and D. Erasme. All-optical half-adder using a single UNI gate. *Journal of Optical Communications*, 27(6):301–304, Dec. 2006.

[503] H. Teimoori, J. D. Topomondzo, C. Ware, and D. Erasme. Optical packet header processing using time-to-wavelength mapping in semiconductor optical amplifiers. *Journal of Lightwave Technology*, 25(8), Aug. 2007.

[504] H. Teimoori, J. D. Topomondzo, C. Ware, R. Gabet, and D. Erasme. All-Optical Packet-Switching Decoder Design and Demonstration at 10 Gbit/s. *Photonics Technology Letters*, 19(10):738 – 740, May 2007.

[505] H. Teimoori, D. Apostolopoulos, K. Vlachos, C. Ware, D. Petrantonakis, L. Stampoulidis, H. Avramopoulos, and D. Erasme. Optical-logic-gate aided packet-switching in transparent optical networks. *Journal of Lightwave Technology*, 26(16):2848 – 2856, July 2008.

[506] C. Thibon, F. Dross, A. Marceaux, and N. Vodjdani. Discussion on RIN improvement using a standard coupler. *IEEE Photonics Technology Letters*, 17(6):1283–1285, June 2005.

[507] Y. Todorov and C. Minot. A modal method for conical diffraction on rectangular slit metallic grating in a multilayer structure. *JOSA A*, 24(10):3100–3114, Oct. 2007.

[508] Y. Todorov, I. Abram, and C. Minot. Dipole emission into rectangular metallic gratings with subwavelength slits. *Physical Review B*, 71(7):075116 (13 pages), Feb. 2005.

[509] Y. Todorov, I. Sagnes, I. Abram, and C. Minot. Purcell Enhancement of Spontaneous Emission from Quantum Cascades inside Mirror-Grating Metal Cavities at THz Frequencies. *Physical Review Letters*, 99(22):223603–1, 223603–4, Nov. 2007.

[510] Y. Todorov, I. Sagnes, U. Gennser, N. Coron, C. Minot, and I. Abram. Spontaneous emission enhancement in quantum cascade structures in the terahertz domain. *Physica Status Solidi (c)*, 4(2):524–527, 2007.

[511] P. Viale, S. Février, P. Leproux, Y. Jaouën, and A.-F. Obaton. Modal properties of a large mode area Bragg fiber. *Photonics and Nanostructures - Fundamentals and Applications*, 4(2):116–122, May 2006.

[512] K. Vlachos, C. Raffaelli, S. Aleksic, N. Andriolli, D. Apostolopoulos, H. Avramopoulos, D. Erasme, D. Klonidis, M. Nordal Petersen, M. Scaffardi, K. Schulze, M. Spiropoulou, S. Sygletos, I. Tomkos, C. Vazquez, O. Zouraraki, and F. Neri. Photonics in switching: enabling technologies and subsystem design. *OSA/ J. Optical Networking*, 8 (5):404–428, 2009.

[513] C. Ware, L. K. Oxenløwe, F. Gómez Agis, H. C. H. Mulvad, M. Galili, S. Kurimura, H. Nakajima, J. Ichikawa, D. Erasme, A. T. Clausen, and P. Jeppesen. 320 Gbps to 10 GHz sub-clock recovery using a PPLN-based opto-electronic phase-locked loop. *Optics Express*, 16(7):5007–5012, Mar. 2008. test.

[514] Q. Xu, A. Arvizu, P. Gallion, and F. J. Mendieta. Homodyne in-phase and quadrature detection of weak coherent states with carrier phase tracking. *IEEE Journal of Selected Topics in Quantum Electronics*, 2009. To appear.

[515] Q. Xu, M. B. Costa E Silva, M. Sabban, P. Gallion, and F. J. Mendieta. Dual-threshold balanced homodyne detection at 1550nm optical fiber quantum key distribution system. *IEEE /OSA Journal of Ligthtwave Technology*, 27(15): 3202–3211, Aug. 2009. To appear.

[516] Q. Xu, M. Sabban, and P. Gallion. Homodyne detection of weak coherent optical pulse with selection of descision opportunity: Applications to quantum cryptography. *Microwave and Optical Technology Letters*, 51(8):1934–1939, Aug. 2009.

[517] L. L. Yi, Y. Jaouën, R. Gabet, W. Hu, Y. Su, and S. Bigo. Improved 10-Gb/s Slow-Light Performances Based on

Broadband Stimulated Brillouin Scattering in Optical Fiber. *Optics Express*, 15:16972–16979, Dec. 2007.
[518] L. L. Yi, Y. Jaouën, W. Hu, J. Zhou, Y. Su, and E. Pincemin. Simultaneous Demodulation and Slow-light of DPSK Signals using SBS-based Optical Filtering in Fiber. *Optics Letters*, 32:3182–3184, Nov. 2007.
[519] Z. D. Zaharis, D. G. Kampitaki, P. I. Lazaridis, A. I. Papastergiou, A. T. Hatzigaidas, and P. Gallion. Improving the radiation characteristics of a base station antenna array using a particle swarm optimizer. *Microwave and Optical Technology Letters,*, 49(7):1690–1698, July 2007.
[520] Z. D. Zaharis, G. Kampitaki, P. I. Lazaridis, A. I. Papastergiou, and P. Gallion. On the design of multi-frequency dividers suitable for GSM/DCS/PCS/UMTS applications by using a particle swarm optimization based technique. *Microwave and Optical Technology Letters*, 49(9):2138–2144,, Sept. 2007.
[521] J. Zhou, J. Chen, Y. Jaouën, L. Yi, X. Li, and P. Gallion. A new frequency model for sbs pump to signal rin transfer in billouin fiber amplifiers. *IEEE Photonics Technology Letters*, 19(13):978–980, July 2007.
[522] J. Zhou, Y. Jaouën, L. Yi, X. Li, and P. Gallion. Pump to stokes noise transfer in cascaded brillouin lasers. *IEEE Photonics Technology Letters*, 20:912–914, June 2008.

4.3.2 ACTI–A: Articles in Proceedings of Major International Conferences

[523] L. Bigot, V. Pureur, Y. Jaouën, Y. Quiquempois, and G. Bouwmans. Ytterbium-doped 2D solid core photonic bandgap fiber for laser operation at 980nm. In *ECOC 2007*, volume paper Mo1.4.6, Berlin, Sept. 2007.
[524] C. Canat, J.-C. Mollier, J. P. Bouzinac, Y. Aubry, G. Loas, and Y. Jaouën. 100 µj generation using a narrow linewidth er^{3+}-yb^{3+} doped fiber mopa and its modeling. In *CLEO'05*, number paper JWB67, Anheim, July 2005.
[525] G. Canat, A. Duceru, Y. Jaouën, S. Bordais, and R. Lebref. Fiber composition influence on spontaneous Brillouin scattering properties in double-clad fiber amplifiers. In *Conference on Lasers and Electro-Optics*, number paper CTuQ4, Long Beach, CA, USA, May 2006.
[526] M. B. Costa E Silva, Q. Xu, S. Agnolini, S. Guilley, J.-L. Danger, P. Gallion, and F. J. Mendieta. Integrating a QPSK Quantum Key Distribution Link. In *European Conference on Optical Communication ECOC'06, CLEO Focus Meeting on Nonlinear, Quantum and Chaotic Optics*, Cannes (France), Sept. 2006.
[527] A. De Rossi, S. Combrié, N. V. Q. Tran, S. Casette, P. Hamel, Y. Jaouën, R. Gabet, and A. Talneau. Structural disorder induced polarization and mode scrambling in photonic crystals. In *Cleo Europe 2007*, volume paper CK10-1-Thu, Munich, June 2007.
[528] D. Fafchamps, G. Rodriguez Guisantes, and P. Gallion. Chi-square statistical models as a good base for the optimisation of optical systems. In *International Conference on Photonics in Switching*, Aug. 2008.
[529] J. Fatome, S. Pitois, P. Tchofo Dinda, D. Erasme, and G. Millot. Experimental comparison of classical and dense dispersion managements for 160-gb/s transmission systems. In *European Conference on Lasers and Electro-Optics (CLEO/Europe 2005)*, number CI3-6-MON, Munich (Germany), May 2005.
[530] I. Fsaifes, C. Lepers, M. Lourdiane, R. Gabet, and P. Gallion. Pulsed laser source coherence time impairments in a direct detection DS-OCDMA system. In *Conference on Lasers and Electro-optics CLEO*, Conference on Lasers and Electro-optics CLEO, May 2006.
[531] R. Gabet, P. Hamel, A.-F. Obaton, E. Burov, G. Melin, and Y. Jaouën. Modal analysis and spatial dispersion evolution in PCF fibres. In *ECOC 2006*, number paper Th1.5.7, Cannes, Sept. 2006.
[532] F. Gómez Agis, C. Ware, D. Erasme, R. Ricken, V. Quiring, and W. Sohler. 10 GHz clock recovery using an opto-electronic phase-locked loop based on three-wave mixing in periodically-poled lithium niobate. In *CLEO*, number JWB34, Long Beach, CA, USA, May 2006.
[533] F. Gómez Agis, C. Ware, and D. Erasme. Sub-clock extraction of optical signals at high rates using an opto-electronic phase-locked loop based on three-wave mixing in periodically-poled lithium niobate. In *CLEO*, number JTuA131, Baltimore, MD, USA, May 2007. Poster.
[534] F. Gómez Agis, C. Ware, D. Erasme, S. Kurimura, and H. Nakajima. Opto-electronic phase-locked loop using adhered-ridge-waveguide periodically poled lithium niobate for high-bit-rate clock recovery. In *Optical Fiber Conference*, number JWA72, San Diego, CA, USA, Feb. 2008.
[535] P. Hamel, Y. Jaouën, R. Gabet, and S. Ramachandran. Chromatic dispersion measurements of few-mod fibres using OLCR technique. In *ECOC 2006*, number paper Th1.5.3, Cannes, Sept. 2006.
[536] P. Hamel, Y. Jaouën, R. Gabet, S. Combrié, N. V. Q. Tran, E. Weidner, A. De Rossi, and A. Talneau. Investigation of group delay and disorder in a photonic crystal waveguide using low-coherence reflectometry. In *CLEO 2007*, number papier CTuG4, Baltimore (USA), May 2007.
[537] S. Hocquet, D. Penninckx, J.-F. Gleyze, and Y. Jaouën. Non-linear phase modulations for control of high power lasers perfomances. In *CLEO 2009*, number papier JThE52, Baltimore (USA), June 2009.
[538] Y. Jaouën, C. Palavicini, A.-F. Obaton, C. Moreau, and P. Sillard. Direct chromatic dispersion determination of higher-order mode fibers using OLCR technique. In *CLEO'05*, number paper Cth4, Baltimore, May 2005.
[539] S. Jiang and P. Gallion. PMD assisted pump to signal noise transfer in distributed raman Amplifier. In *Optical Fiber Communication Conference, OFC 2008, Paper OTuN6,*, pages Paper OTuN6,, San Diego, California, Feb. 2008.
[540] F. Kefelian, R. Gabet, and P. Gallion. Phase noise characterization of a RF signal generation and transmission optical system based on injection locked DFB lasers. In *Conference on Lasers and Electro-Optics Europe 2005*, volume 29B, page 142, MUNICH (RFA), June 2005.
[541] V. Lanticq, R. Gabet, J.-L. Auguste, S. Lesoille, S. Fortier, and Y. Jaouën. Spontaneous brillouin scattering modelling and measurement in various axisymetric optical fibres. In *ECOC 2007*, volume paper P004, Berlin, Sept. 2007.

[542] V. Lanticq, S. Jiang, R. Gabet, Y. Jaouën, S. Delepine-Lesoille, and J.-M. Henault. Self-referenced method to measure the gain coefficient in optical fibers. In *ECOC 2008*, number paper Tu.3.B.2, Bruxelles, Oct. 2008.
[543] C. Lesvignes, V. Couderc, P. Leproux, Barthelemy, J.-L. Auguste, D. Pagnoux, X. Daxhelet, S. Lacroix, and Y. Jaouën. Second harmonic generation in a highly birefringent nonlinear microstructured fibre. In *ECOC 2006*, number paper Th3P188, Cannes, Sept. 2006.
[544] S. Mumtaz, G. Rekaya-Ben Othman, Y. Jaouën, and G. Charlet. Efficient interleaving of fec for optical psk systems. In *ECOC 2009*, number paper P3.02, Vienne, Autriche, Sept. 2009. To appear.
[545] L. K. Oxenløwe, F. Gómez Agis, C. Ware, S. Kurimura, H. C. H. Mulvad, M. Galili, K. Kitamura, H. Nakajima, J. Ichikawa, D. Erasme, A. T. Clausen, and P. Jeppesen. 640 Gbit/s data transmission and clock recovery using an ultra-fast periodically poled lithium niobate device. In *Optical Fiber Conference*, number PDP22, San Diego, CA, USA, Feb. 2008. Postdeadline paper.
[546] M. Patterson, S. Hughes, S. Combrié, N. V. Q. Tran, A. De Rossi, R. Gabet, and Y. Jaouën. Disorder-induced coherent scattering in slow-light photonic crystal waveguides. In *CLEO 2009*, page paper JTuF3, Baltimore (USA), June 2009.
[547] J. Petit, D. Erasme, C. Kazmierski, C. Jany, J. Decobert, F. Alexandre, N. Dupuis, and R. Gabet. Enhanced 10-Gb/s NRZ Transmission Distance using Dual Modulation of an Integrated Electro-absorption Modulated Laser Transmitter. In *Optical Fiber Communication Conference*, number OThG2, San Diego, California, USA, Mar. 2009.
[548] J. Renaudier, B. Lavigne, M. Jourdran, P. Gallion, F. Lelarge, B. Dagens, A. Accard, O. Le Gouezigou, and G. H. Duan. First demonstration of all-optical clock recovery at 40 GHz with standard-compliant jitter characteristics based on a quantum-dots self-pulsating semiconductor laser. In *European Conference on Optical Communication ECOC05*, page Post DeadLine Paper Th4.3.4, Glasgow (Scotland), Sept. 2005.
[549] J. Renaudier, B. Martin, F. Poingt, F. Pommereau, L. Legouezigou, F. Lelarge, F. Martin, O. Le Gouezigou, J.-G. Provost, P. Gallion, B. Thedrez, and G. H. Duan. "polarization insensitive 40ghz self-pulsating dbr lasers with enhanced nonlinearities and wide self-pulsation frequency tunability". In *Conference on Lasers and Electro-optics CLEO 2005*, Baltimore (MD), May 2005.
[550] M. Sabban, Q. Xu, P. Gallion, and F. J. Mendieta. Security evaluation of dual-threshold homodyne quantum cryptographic systems. In *2008 Quantum Entanglement and Decoherence: 3rd International Conference on Quantum Information (ICQI) Topical Meeting. ICQI*, Boston (MS), July 2008.
[551] M. Selmi, Y. Jaouën, and P. Ciblat. Accurate digital frequency offset estimator for coherent polmux qam transmission systems. In *European Conference on Optical Communications (ECOC)*, number paper P3.08, Vienne, Autriche, Sept. 2009. To appear.
[552] A. Tan, A. Bezard, E. Pincemin, Y. Jaouën, A. Tonello, S. Wabnitz, J.-D. Anai-Castanon, and S. Turitsyn. Performance comparison of duobinary modulation formats for 40 Gb/s long-haul WDM transmissions. In *ECOC 2006*, number paper We3P94, Cannes, Sept. 2006.
[553] A. Tan, E. Pincemin, Y. Jaouën, A. Tonello, S. Wabnitz, J. D. Castanon, S. K. Turitsyn, and L. Gruner-Nielsen. Can SSMF handle ULH 40-Gb/s WDM transmission? In *ECOC 2007*, volume paper P098, Berlin, Sept. 2007.
[554] C. Ware and D. Erasme. 30 GHz sub-clock recovery using an opto-electronic phase-locked loop based on four-wave mixing in a semiconductor optical amplifier. In *CLEO/Europe*, number CI3-5-MON, Munich, Germany, June 2005.
[555] Q. Xu, M. B. Costa E Silva, P. Gallion, and F. J. Mendieta. One way differential qpsk quantum key with channel impairment compensation. In *Conference on Lasers and Electro-optics CLEO Europe, JOINT CLEO/Europe-IQEC 2007 SYMPOSIA*, München (Germany), June 2007.
[556] Q. Xu, M. B. Costa E Silva, A. Arvizu, P. Gallion, and F. J. Mendieta. Weak coherent state homodyne detection with sequential i-q measurements. In *IEEE/OSA/APS Conference on Lasers and Electro-optics and Quantum Electronics and Laser Science Conference CLEO/QELS 2008*, San Jose, California, May 2008.
[557] Q. Xu, M. B. Costa E Silva, P. Gallion, and F. J. Mendieta. Auto-compensating quantum Cryptosystem using homodyne detection. In *Optical Fiber Communication Conference, OFC 2008,*, pages San Diego, California, Feb. 2008.
[558] L. Yi, Y. Jaouën, R. Gabet, W. Hu, Y. Su, and S. Bigo. 10-Gb/s slow-light performance based on SBS effect in optical fiber using NRZ and PSBT modulations formats. In *ECOC 2007*, volume paper We6.6.2, Berlin, Sept. 2007.
[559] L. Yi, Y. Jaouën, W. Hu, J. Zhou, Y. Su, and E. Pincemin. Simultaneous demodulation and slow-light delay of DPSK signals at flexible bit-rates using bandwidth-tunable SBS in optical fibre. In *ECOC 2007*, volume paper We6.6.1, Berlin, Sept. 2007.
[560] Z. Zhang, A. Locquet, P. L. Voss, and P. Gallion. A Simple, Extremely Large Bandwidth, Modulator-Free QKD System. In *Conference on Lasers and Electro-optics CLEO Europe, JOINT CLEO/Europe-IQEC 2007 SYMPOSIA*, pages aper JSI 2–5 Thu, München (Germany), June 2007, June 2007.
[561] J. H. Zhou, L. L. Yi, Y. Jaouën, J. P. Chen, and P. Gallion. Pump-to-stoke relative intensity noise transfer in brillouin fiber amplifiers. In *33rd European Conference on Optical Communication, ECOC 2007*, page Paper 2.4.3, Berlin (Germany), Sept. 2007.

4.3.3 ACTI–B: Articles in Proceedings of Other International Conferences

[562] W. Aktar, P. Gallion, and M. Gharei. Hybridization readiness for multiservice broadband networks. In *IEEE 16th International Conference on Telecommunications (ICT)*, Marrakech, Marocco, May 2009.
[563] D. Armand, Y. Todorov, F. Garet, J. L. Coutaz, and C. Minot. Evidence of THz Surface Plasmon-like Wave Propa-

gation along a 1D Metallic Grid. In *Joint 32nd International Conference on Infrared and Millimetre Waves and 15th International Conference on Terahertz Electronics*, Cardiff, Royaume Uni, Sept. 2007.

[564] O. Audouin, D. Erasme, M. Jouvin, O. Leclerc, C. Mouton, P. Primet, D. Rodrigues, and L. Thual. CARRIOCAS project: An experimental high bit rate optical network for for computing intensive distributed applications. In *Broad-Band Europe'07*, page Tu3A4, Anwerpen Belgique, Dec. 2007.

[565] B. Bennai, V. Jolivet, P. Bourdon, E. Pourtal, G. Canat, Y. Jaouën, and O. Vasseur. Coherent combining amplifiers: from single-mode fiber demonstration to large-mode-area modelling. In *Europhoton 2008*, Paris, Sept. 2008.

[566] P. Bourdon, B. Bennai, V. Jolivet, B. G. Moreau, O. Vasseur, and Y. Jaouën. Coherent beam combining of fiber amplifier arrays ans application to laser beam propagation through turbulent atmosphere. In *Photonics West 2008*, pages paper 6873–41, Jan. 2008.

[567] M. B. Costa E Silva, Q. Xu, S. Agnolini, P. Gallion, and F. J. Mendieta. Homodyne detection for quantum key distribution : an alternative to photon counting. In *International Conference On Applications of Photonic Technology, Photonics North 2006,*, Quebec City, (Canada),, June 2006.

[568] M. B. Costa E Silva, Q. Xu, S. Agnolini, P. Gallion, and F. J. Mendieta. Homodyne QPSK Detection for Quantum Key Distribution. In *Coherent Optical Technologies and Applications (COTA) Topical Meeting. of the OAA*, Whistler B.C. (Canada), June 2006.

[569] A. De Rossi, S. Combrié, Q. V. Tran, C. Huscko, G. Vadala, P. Hamel, R. Gabet, Y. Jaouën, A. Parini, Y. Gottesman, and F. Raineri. Impact on nonlinearity and disorder on slow modes in membrane photonic crystal. In *Slow and Fast light 2008*, volume paper SWC2, Boston (USA), July 2008.

[570] A. Farhat, M. Mnif, C. Lepers, H. Rezig, and P. Gallion. Importance Sampling Applied to an Optical DS-CDMA System. In *IEEE International Conference on Electronics, Circuits and Systems ICECS, 2007,*, number paper 2284, Marrakech, Morocco,, Dec. 2007.

[571] P. Gallion, R. Vallet, M. Lourdiane, I. Fsaifes, C. Lepers, and V. Beugin. Accès multiple par code : des réseaux sans fils aux réseaux optiques. In *Colloque International Optique Hertzienne et Diélectriques*, Hammamet (Tunisie), Sept. 2005.

[572] P. Gallion, J. Renaudier, G. H. Duan, and B. Lavigne. Semiconductor lasers for optical clock recovery. In *Optics East, SPIE conference: "Active and Passive Optical Components for Communications VI*, Boston, Massachusetts, Oct. 2006.

[573] P. Gallion, J. H. Zhou, S. F. Jiang, J. P. Chen, and Y. Jaouën. Noise in Distributed Raman Amplification, Invited Paper. In *Asia-Pacific Optical Communications (APOC),*, Oct. 2007.

[574] M. Gharei, C. Lepers, I. Fsaifes, and P. Gallion. A novel reconfigurable ring architecture of multiple secure private networks over EPON using OCDMA code-drop units. In *Photonics North*, 2008.

[575] F. Gómez Agis, C. Ware, and D. Erasme. Clock synchronization and sub-clock extraction of optical signals at high rates using an opto-electronic PLL based on three-wave mixing in PPLN. In *International Conference on Transparent Optical Networks (ICTON)*, Rome, Italy, July 2007. Invited conference.

[576] S. Grot, L. Goldberg, P. Besnard, and Y. Jaouën. High-performance pulsed coherent fiber laser emitting $>$ 1.7k w at 1060-nm in ns regime. In *Photonics West'05*, number paper CthB4, Anheim, Jan. 2005.

[577] A. Guernache, V. Voiriot, D. Locatelli, F. Legrand, N. Bouche, F. Lelarge, R. M. Capella, P. Gallion, and J. Jaquet. Over 0.7-W 14xx-nm FBG-stabilised output power InP based pump laser. In *European Conference on Integrated Optics ECIO'05*, Grenoble, Apr. 2005.

[578] J.-F. Huang, P. Gallion, Y.-T. Chang, and L.-W. Chou. Confidential enhancement with active reconfigurable awg-based codecs over fiber-to-the-home network. In *IASTED International Conference, Wireless and Optical Communications (WOC 2008)*, Quebec City Canada, May 2008.

[579] Y. Jaouën, R. Gabet, and P. Hamel. Optical low-coherence reflectometry for characterization of specialty fibers and photonics crystal waveguides. In *Photonics North 2008*, volume paper FLD-3-4-1, Montreal (Canada), June 2008.

[580] F. Kefelian and P. Gallion. Theoretical analysis of forward and backward optical injection locking configuration in semiconductor Fabry-Perot and DFB lasers. In *Photonics Europe 2006*, number 6184-18, page 85, Strasbourg, Apr. 2006.

[581] S. Khemiri, C. Ware, R. Gabet, and D. Erasme. 10 GHz Short Pulse Clocked Optical Source Based on Four-Wave Mixing in an Optical fibre. In *12th IEEE International Conference on Electronics, Circuits and Systems*, number Optical network and system III, Gammarth (Tunisie), Dec. 2005.

[582] P. Lazaridis, G. Debarge, P. Gallion, Z. Zaharis, D. Kampitaki, A. Hatzigaidas, A. Papastergiou, and G. Grammatikopoulos. Signal compression method for biomedical image using the discrete orthogonal gauss-hermite transform. In *6th WSEAS International Conference on Signal Processing, Computational Geometry & Artificial Vision (ISCGAV'06)*, Elounda, Agios Nikolaos, Crete Island, Greece, Aug. 2006.

[583] M. Menif, P. Gallion, C. Karaborni, and H. Rezig. Performance evolution for a new implementation of multirate optical fast frequency hopping cdma system for multimedia transmission. In *12th IEEE International Conference on Electronics, Circuits and Systems, ICECS 2005*, page 186, Gammarth, (Tunisia), Dec. 2005.

[584] A.-F. Obaton, P. Hamel, R. Gabet, Y. Jaouën, E. Burov, G. Melin, M. Lievre, and J. Dubard. Comparative measurement of group velocity dispersion on micro-structured fibre using optical low coherence reflectometry. In *OFMC 2007*, Teddington, UK, Oct. 2007.

[585] H. Teimoori, J. D. Topomondzo, C. Ware, R. Gabet, and D. Erasme. All-Optical 3*8 SOA-based Decoder Design and Demonstration at 10 Gbit/s for Packet-Switching Applications. In *Broadband Europe'06*, Geneva, Dec. 2006.

[586] C. Ware, S. Cordette, C. Lepers, I. Fsaifes, B. Kibler, C. Finot, and G. Millot. Spectral slicing of a supercontinuum source for WDM/DS-OCDMA application. In *International Conference on Transparent Optical Networks (ICTON)*, Athens, Greece, June 2008. Invited conference.

[587] Q. Xu, M. B. Costa E Silva, J.-L. Danger, S. Guilley, P. Bellot, P. Gallion, and F. J. Mendieta. Towards quantum key

distribution system using homodyne detection with differential time-multiplexed reference. In *5th IEEE International Conference on Information and Communication Technologies RIVF 2007*, pages 158–165, Hanoi (Vietnam), Mar. 2007.

[588] Q. Xu, M. Sabban, P. Gallion, and F. J. Mendieta. Quantum key distribution system using dual-threshold homodyne detection. In *6th IEEE International Conference on Information and Communication Technologies RIVF 2007, Ho Chi Mim Ville (Vietnam),*, Ho Chi Mim Ville (Vietnam), July 2008.

[589] L. Yi, Y. Jaouën, W. Hu, Y. Su, and P. Gallion. SBS Based Slow-Light Performance Comparison of 10-Gb/s NRZ, PSBT and DPSK Signals. In *"Asia-Pacific Optical Communications (APOC)*, Wuhan PRC, Feb. 2007.

[590] L. Yi, Y. Jaouën, W. Hu, Y. Su, and P. Gallion. SBS based slow-light performances comparison of 10-Gb/s NRZ, PSBT and DPSK signals. In *APOC 2007*, pages paper 6783–19, Wuhan (Chine), Oct. 2007.

4.3.4 ACLN: Articles in Other Refereed Journals

[591] P. Hamel, R. Gabet, A.-F. Obaton, E. Burov, G. Melin, and Y. Jaouën. Mesure de la dispersion chromatique de fibres micro-structurées par réflectométrie à faible cohérence. *Revue française de métrologie*, 2006-4(8):3–11, Jan. 2007.

[592] C. Palavicini, Y. Jaouën, P. Gallion, and G. Campuzano. Caracterizacion de componentes fotonicos utilizando reflectometra optica de baja coherencia. *Revista Mexicana de física*, 52(4):379–386, Aug. 2006.

4.3.5 ACTN: Articles in Proceedings of French Conferences

[593] B. Bennai, V. Jolivet, P. Bourdon, C. Coudrain, Y. Jaouën, and O. Vasseur. Etude des fluctuations de phase et combinaison cohérente de lasers a fibre en vue de la réalisation d'une source de forte énergie. In *JNOG 2007*, volume papier ME1, Grenoble, July 2007.

[594] A. Bezard, A. Tan, E. Pincemin, Y. Jaouën, A. Tonello, and S. Wabnitz. Performances des formats duobinaires pour la transmission longue distance à 40 Gb/s. In *JNOG 2006*, number papier A-TH1-9, Metz, Nov. 2006.

[595] L. Bigot, V. Pureur, Y. Jaouën, Y. Quiquempois, and G. Bouwmans. Laser à 980nm basé sur une fibre toute solide à bandes photoniques interdites dopée ytterbium. In *JNOG 2007*, volume papier MA8, Grenoble, July 2007.

[596] G. Canat, Y. Jaouën, J.-C. Mollier, S. Bordais, J. P. Bouzinac, and Y. Aubry. Conception d'amplificateurs à fibre dopée er3+/yb3+ de puissance : application à la génération d'impulsions 100 µj. In *JNOG 2005*, number papier 5_8, Chambéry, Nov. 2005.

[597] S. Cordette, B. Kibler, I. Fsaifes, C. Lepers, C. Ware, C. Finot, and G. Millot. étude expérimentale d'un système hybride WDM/DS-OCDMA pour réseau d'accès optique haut débit. In *Journées Nationales d'Optique Guidée JNOG'08*, Lannion, France, Oct. 2008. Poster.

[598] I. Fsaifes, C. Lepers, M. Lourdiane, and P. Gallion. Encodage spectral à réseaux de Bragg pour les systèmes CDMA tout optiques. In *JNOG 2005*, Chambéry, Nov. 2005.

[599] I. Fsaifes, C. Lepers, R. Gabet, M. Douay, and P. Gallion. étude expérimentale d'un système DS-OCDMA cohérent à réseaux de Bragg superstructurés. In *26èmes Journées Nationales d'Optique Guidée JNOG*, Grenoble France, July 2007.

[600] I. Fsaifes, C. Lepers, R. Gabet, M. Douay, and P. Gallion. étude expérimentale d'un système ds-ocdma cohérent à réseaux de bragg superstructurés. In *26es Journées Nationales d'Optique Guidée JNOG*, Apr. 2009.

[601] R. Gabet, K. Clément, G. Melin, A.-F. Obaton, E. Burov, and Y. Jaouën. Caractérisation modale de fibres microstructurées par réflectométrie à faible cohérence. In *JNOG 2005*, number papier 2_5, Chambéry, Nov. 2005.

[602] F. Gómez Agis, C. Ware, D. Erasme, R. Ricken, V. Quiring, and W. Sohler. Récupération d'horloge par une boucle à verrouillage de phase opto-électronique utilisant le mélange à trois ondes dans le niobate de lithium périodiquement inversé. In *Journées nationales d'optique guidée*, Chambéry, France, Nov. 2005.

[603] F. Gómez Agis, C. Ware, and D. Erasme. Extraction d'horloge des signaux optiques par une boucle à verrouillage de phase opto-electronique utilisant un dispositif en niobate de lithium à inversion de domaines. In *Journées Nationales d'Optique Guidée*, Grenoble, France, July 2007.

[604] F. Gómez Agis, C. Ware, L. Oxenløwe, S. Kurimura, H. Mulvad, M. Galili, and D. Erasme. Récuperation d'horloge d'un signal OTDM à 640 Gbit/s transmis sur 50 km par boucle à verrouillage de phase opto-électronique utilisant un dispositif en niobate de lithium à inversion de domaines. In *Journées Nationales d'Optique Guidée JNOG'08*, Lannion, France, Oct. 2008.

[605] V. Lanticq, S. Jiang, R. Gabet, Y. Jaouën, S. Delepine-Lesoille, and J.-M. Henault. Mesure auto référencée du coefficient de gain brillouin dans les fibres optiques monomodes. In *JNOG 2008*, page papier A8.11, Lannion, Oct. 2008.

[606] V. Lanticq, S. Jiang, R. Gabet, Y. Jaouën, S. Delepine-Lesoille, and G. Moreau. Mesure auto référencée du coefficient de gain brillouin dans les fibres optiques monomodes. In *CMOI 2008*, page Session8, Nantes, Nov. 2008.

[607] A. Maalouf, P. Hamel, D. Bosc, Y. Jaouën, S. Haesaert, F. Henrio, P. Grosso, M. Gadonna, Y. Gottesman, and R. Gabet. Caractérisation de micro-résonateurs polymère par réflectométrie à faible cohérence. In *JNOG 2007*, volume papier ME9, Grenoble, July 2007.

[608] S. Sahuguede, D. Fafchamps, A. Julien-Vergonjanne, G. Rodriguez, J.-P. Cances, P. Gallion, and J.-M. Dumas. Performances du decodage ldpc sur un anneau optique fonctionnant en mode paquet. In *27èmes Journées Nationales d'Optique Guidée JNOG,*, Lannion (France), Oct. 2008.

[609] H. Teimoori, C. Ware, and D. Erasme. Application du mélange à quatre ondes à la conversion série / parallèle. In *Journées Nationales d'Optique Guidée JNOG'05*, Chambery (France), Nov. 2005.
[610] H. Teimoori, C. Ware, J. D. Topomondzo, and D. Erasme. Traitement du label de paquets optiques pour les réseaux optiques de communications. In *Journées Nationales d'Optique Guidée JNOG'07*, Grenoble (France), June 2007.
[611] L. Yi, Y. Jaouën, W. Hu, Y. Su, and R. Gabet. Ralentissement de signaux à 10Gb/s par effet Brillouin dans une fibre optique. In *JNOG 2007*, volume paper JE3, Grenoble, July 2007.

4.3.6 ASCL: Articles in Journals without review committee

[612] P. Gallion. Le ftth : La révolution de l'optique. *La revue TELECOM, ISSN 1769-338*, (153):59–64, Apr. 2009.

4.3.7 COM: Talks in Conferences Which Do Not Publish Proceedings

[613] S. Agnolini and P. Gallion. Quantum key distribution implementations by QPSK modulation using a single dual-electrode mach-zehnder modulator. In *Symposium on Technology Fusion of Optoelectronics and Communications, SFTOC'05,*, number 19T07, Taipei (ROC), Oct. 2005.
[614] G. Campuzano and P. Gallion. Static/dynamic locking range dependence on grating characteristics of index-coupled DFB lasers. In *Sixth Symposium Optics in Industry*, Monterrey (Mexico), 2007.
[615] G. Canat, J.-C. Mollier, and Y. Jaouën. Performances and limitations of high brightness erbium-ytterbium fiber sources. In *Journées scientifiques ONERA*, Chatillon, June 2005.
[616] D. Erasme and T. B. Consortium. Broadband-for-all in europe and in the world: the analysis of the eu-bread project. In *2005 Optics Valley of China International Symposium on Optoelectronics*, Wuhan (Chine), Nov. 2005.
[617] R. Gabet, K. Clément, C. Lepers, and Y. Jaouën. Caractérisation de fibres microstructurées par réflectométrie à faible cohérence. In *Colloque du GDR Ondes*, Marseille, June 2005.
[618] P. Gallion. Récents travaux sur le cdma optique". In *Technologies dAccès et Evolutions Futures, Etat de lArt et Perspectives*, Oct. 2005.
[619] P. Gallion. Advanced concepts and devices for optical communications and networking. In *GET-NTP Broadband & Wireless Communications WORKSHOP*, Hsinchu Taiwan, Nov. 2006.
[620] V. I. Gavrilenko, K. V. Maremyanin, M. I. Orlov, D. V. Ushakov, N. Dyakonova, W. Knap, Y. Todorov, I. Sagnes, and C. Minot. Generation of terahertz radiation in quantum cascade structures. In *Annual symposium on Nanophysics and Nanoelectronics*, pages 543–544, Nizhny Novgorod, Russie, Mar. 2007.
[621] F. Gómez Agis, C. Ware, D. Erasme, R. Ricken, V. Quiring, and W. Sohler. 10 GHz clock recovery using three-wave mixing in PPLN. In *COST 288*, Saint-Andrews, Royaume-Uni, Aug. 2005.
[622] F. Gómez Agis, C. Ware, D. Erasme, R. Ricken, V. Quiring, and W. Sohler. 30 GHz sub-clock recovery using three-wave mixing in PPLN. In *COST 291*, Cannes, France, Sept. 2006.
[623] A. Guermache, V. Voiriot, N. Bouche, D. Locatelli, F. Legrand, B. Ligat, R. M. Capella, and J. Jacquet. Experimental demonstration of output power improvement of 1.48 µm pump lasers by spatial hole burning reduction. In *International Workshop on PHysics and Applications of SEmiconductor LASERs*, Metz (France), Mar. 2005.
[624] Y. Jaouën, G. Canat, S. Grot, and S. Bordais. Power limitation induced by nonlinear effects in pulsed high-power fiber amplifier. In *Journées scientifiques ONERA*, Chatillon, June 2005.
[625] Y. Jaouën, G. Canat, J.-C. Mollier, and J. P. Bouzinac. Performances and limitations of high brightness erbium-ytterbium fiber sources. In *RFLS 2005*, Nice, Sept. 2005.
[626] F. Kefelian, R. Gabet, and P. Gallion. Phase noise characterization of a RF signal generation and transmission optical system based on injection locked DFB lasers. In *International Workshop on PHysics and Applications of SEmiconductor LASERs,*, page 30, Metz (France), Mar. 2005.
[627] C. Minot, Y. Todorov, I. Abram, U. Gennser, and I. Sagnes. Contrôle de l'émission térahertz dans les super-réseaux en microcavité. In *3èmes Journées Térahertz*, pages 5–8, Aussois (France), Mar. 2005.
[628] J. Renaudier, L. Legouezigou, F. Poingt, F. Pommereau, F. Lelarge, F. Martin, O. Le Gouezigou, J.-G. Provost, P. Gallion, B. Thedrez, and G. H. Duan. Polarization insensitive 40 GHz self-pulsating DBR lasers with wide self-pulsation frequency tunability. In *International Workshop on PHysics and Applications of SEmiconductor LASERs,*, Apr. 2005.
[629] H. Teimoori, D. Apostolopoulos, K. Vlachos, C. Ware, D. Petrantonakis, L. Stampoulidis, H. Avramopoulos, and D. Erasme. Physical architectures for packet-switching network nodes based on non-linear logic gates. In *6th Symposium on Communication Systems, Networks and Digital Signal Processing, CSNDSP08*, Graz, Austria, Aug. 2008.
[630] J. D. Topomondzo, D. Erasme, E. Alvarez, H. Soto, and G. Debarge. Experimental determination of coupling coefficient in semiconductor optical amplifier subjected to the cross polarization modulation. In *PHOTONICS PRAGUE 2005, 5th International Conference on Photonics, Devices and Systems*, volume 6180, Prague, June 2005.
[631] Q. Xu, M. B. Costa E Silva, S. Agnolini, P. Gallion, and F. J. Mendieta. Photon Counting and Super Homodyne Detection of Weak QPSK Signals for Quantum Key Distribution Applications. In *EOS Annual Meeting 2006, Topical Meeting on Extreme Optics (QEOD/EPS and EOS)*, Paris, Oct. 2006.
[632] Q. Xu, M. B. Costa E Silva, P. Gallion, and F. J. Mendieta. Experimental super homodyne quantum key distribution system. In *École d'été e-Photon/One+ 2007*, Brest France, July 2007.
[633] Q. Xu, M. Sabban, P. Gallion, and F. J. Mendieta. Dual threshold receiver for 1550nm homodyne qpsk quantum

key distribution system. In *2008 Coherent Optical Technologies and Applications (COTA) Topical Meeting.*, Boston (MS), July 2008.

4.3.8 OS: Books and Book Chapters

[634] J. C. Bouley. Lasers à semi-conducteurs. In *Sciences et Techniques: Electronique*, chapter E 2660, page 16 p. Editions Techniques de l'Ingénieur, Paris, 2007.

[635] G. Campuzano and P. Gallion. Theory of Injection Locking and Quantum Static/dynamic locking range dependence on grating characteristics of index-coupled DFB lasers. In J. C. G.-V. J. D.-R. C. L.-M. Editors, editor, *Proceedings of SPIE-Volume 6422*. SPIE, Bellingham, WA, 2008, 2007.

[636] A. Farhat, M. Mnif, C. Lepers, H. Rezig, and P. Gallion. Impact of the unipolar family codes on the performances of the dsocdma system. *Proceedings of SPIE, Optical Transmission, Switching, and Subsystems VI, Editor(s): Kenichi Kitayama; Pierpaolo C. Ghiggino; Kim Roberts; Yikai Su, ISBN: 9780819473769Editors , SPIE Bellingham, WA, December 2008*, 7136, Dec. 2008.

[637] I. Fsaifes, M. Lourdiane, C. Lepers, R. Gabet, V. Beugin, and P. Gallion. Performance of a 1gbps optical direct sequence cdma based on sampled fiber bragg grating. In P. Mascher, A. P. Knights, J. C. Cartledge, and D. V. Plant, editors, *Proceedings of SPIE, Vol 5970, Photonic Applications in Devices and Communication Systems*, pages 713–718. SPIE, Bellingham, WA, (USA), 2005.

[638] P. Gallion, J. Renaudier, G. H. Duan, and B. Lavigne. Self-pulsating semiconductor lasers for high bit-rate all-optical clock recovery. In A. K. Dutta, Y. Ohishi, N. K. Dutta, and J. Moerk, editors, *Proceedings of SPIE-Volume 6389 : Active and Passive Optical Components for Communications VI*. SPIE, Bellingham, WA, USA, 2007.

[639] P. Gallion, J. H. Zhou, S. F. Jiang, J. P. Chen, and Y. Jaouën. Noise in distributed Raman amplification. In M.-J. Li, J. Chen, S. Kawanishi, and I. H. White, editors, *Active and Passive Optical Components for Communications VI*, volume 6781. SPIE, Bellingham, WA, Nov. 2007.

[640] P. Gallion, F. J. Mendieta, and S. Jiang. *Signal and quantum noise in optical communcation and in cryptography*, pages 149–259. Elsevier, Amsterdam, 2009.

[641] Y. Jaouën, R. Gabet, and P. Hamel. Optical low-coherence reflectometry for characterization of specialty fibers and photonics crystal waveguides. *Photonics North 2008 Proceedings of SPIE*, pages paper 7099–19, Aug. 2008.

[642] F. Kefelian and P. Gallion. Theoretical analysis of optical injection locking in semiconductor DFB lasers, influence of the injection direction. In I. H. W. D. Lenstra, M. Pessa, editor, *Proc. of SPIE vol. 6184 Semiconductor Lasers and Laser Dynamics II* , pages 147–157. SPIE, Bellingham, USA, 2006.

[643] L. Yi, Y. Jaouën, W. Hu, Y. Su, and P. Gallion. SBS Based Slow-Light Performance Comparison of 10-Gb/s NRZ, PSBT and DPSK Signals. In *Proceedings of SPIE-Volume 6XXX: Active and Passive Optical Components for Communications VI ,*. SPIE, Bellingham, WA, 2008, 2008.

4.3.9 AP: Other Productions: Database, Registred Software, Registred Patent, . . .

[644] J. M. Moison and C. Minot. Réseaux de guides d'ondes permettant de dévier un faisceau lumineux. (07/54872), Sept. 2007.

[645] S. Mumtaz, G. Rekaya-Ben Othman, and Y. Jaouën. Procédé et dispositif de modulation mettant en œuvre une modulation différentielle, procédé et dispositif de démodulation, signal et produits programme d'ordinateur correspondants. (FR 09/52207), Apr. 2009.

[646] S. Sahuguede, D. Fafchamps, A. Julien-Vergonjanne, G. Rodriguez, J.-P. Cances, P. Gallion, and J.-M. Dumas. Ldpc soft decision fec performance in an optical packet ring network, Sept. 2009.


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