University of California Los Angeles

EE 272: Dynamics of Lasers

Instructor: Prof. F. Grillot

Objective: the lecture aims at giving an extended overview of physics and applications of laser dynamics. The course will pick-up various illustrations including but not limiting to semiconductor lasers. Prerequisite for this course is EE271. Several assignments will be scheduled.

Part I: Advanced laser dynamics

- Rate equations
- Linear stability analysis
- Bifurcations
- Semiconductor lasers
- Linewidth broadening factor
- Gain nonlinearities
- Relaxation oscillation and damping
- High-speed lasers
- Dynamics of quantum cascade lasers
- Dynamics of spontaneous emission with meso- and nanolasers

Part II: Nonlinear laser dynamics

- Arrechi's classification
- Stability analysis
- Lyapunov exponent, entropy
- Chaotic light at mid-infrared wavelengths
- Injection-locking
- Optical feedback
- Photonics-RF generation
- Secured optical communications
- Random bit generation
- Beam shaping
- Mesoscopic chaos

Part III: Ultra-fast laser dynamics

- How fast is ultrafast?
- Anatomy of a laser pulse
- Gain switching
- Q-switching
- Cavity dumping
- Passive, active and hybrid mode-locking
- Self-pulsations
- Optical parametric oscillators
- Pulse compression
- Pulse measurement technique: autocorrelation, FROG, streak cameras, etc.

References

[1] J. M. Liu, Photonic Devices, Cambridge University Press.
[2] T. Erneux and P. Glorieux, Laser Dynamics, Cambridge
[3] A. Uchida, Optical Communications with Chaotic Lasers, Wiley.
[4] L. A. Coldren & S. W. Corzine, Diode Lasers and Photonic Integrated Circuits, Wiley
[5] J. Faist, Quantum Cascade Lasers, Oxford University Press