



TTool

An Open-Source Simulator for Real-Time SysML Models

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Rationale

- **Real-time systems capture complex engineering problems that stimulate research work on model-based engineering**
 - Early detection of design errors using model simulation
- **Experience in joint use of UML (Unified Modeling Language) and formal methods (timed automata, timed process algebras)**
 - TURTLE (Timed UML and RT-LOTOS Environment)
 - Open source toolkit **TTool**
- **SysML (System Modeling Language) is the emerging modeling language for systems engineers**
 - AVATAR (Automated Verification of reAl Time softwARe)
 - Open source toolkit **TTool**

Method

Requirement Capture

Modeling Assumptions

Analysis

Design - Architecture

Properties To Verify

Design - Behaviors

Prototyping

AVATAR

Requirement Diagrams

Use-Case Diagrams

Activity Diagrams

Sequence Diagrams

Block Instance Diagrams

Parametric Diagram

State Machines Diagrams

TTool

Editor

Editor

Editor

Simulator

→ UPPAAL

→ ProVerif

C Code Generator

→ Emulation platform



AVATAR and TTool by example

Future Air Navigation System

Connection Set Up



Real-Size Case Study

Autopilot

Conclusions and Future Work

- **AVATAR**
 - Real-Time and distributed systems modeling
 - Compliant with OMG's SysML
 - Formal semantics
- **TTool**
 - Open-source
 - Google "TTool" or download from ttool.telecom-paristech.fr/
 - Simulator
 - Formal verification: safety (UPPAAL) and security (ProVerif)
 - Code generation → emulation
- **Ongoing work**
 - Methodological assistant
 - Case studies (protocols, aerospace engineering, medical systems)
 - Tutorials and training material



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