ETH
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Swiss Federal Institute of Technology Zurich

TIK
Institut für Technische Informatik
und Kommunikationsnetze
Computer Engineering and
Networks Laboratory

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Master Thesis:

# Towards Probabilistic Scheduling of Mixed-Criticality Systems

**The Problem:** Complex embedded systems typically have functionalities of different importances (criticality levels). As an example, the airplane software applications can be usually categorized as flight critical or mission critical, where for flight critical applications like the autopilot, failures (e.g. pilot commands not being transmitted in time) could result in an airplane crash, while for mission critical applications like the radio communication or the passengers' video entertainment, the consequences of failures (e.g. loss of communication or wrongly decoded videos) are not severe. On the other hand, various unexpected situations may happen during the operation of an airplane, since neither the hardware nor the software we build for airplanes are perfect. How should the system react to such unexpected situations? And which properties should/can we guarantee in such dynamic and mixed-criticality environments? To answer those questions, smart online scheduling algorithms that can react to unexpected scenarios need to be developed.

**The Thesis:** In this thesis, we consider real-time scheduling and model the potential risk, i.e. task overrun, with random processes. We aim at explicitly guaranteeing system safety according to existing safety standards, while satisfying system schedulability.


Specifically, the student will perform analysis on how the deadline miss probabilities are related to overrun risks, and further infer the safety property. To further enhance resource efficiency, we will assume degrading less critical tasks when risks last long in the system. This poses further challenges on quantifying the impact of degradation on both system safety and schedulability. The essential task here would be to find when is the "right" moment to perform such kinds of rescue operations. Throughout the thesis,

- you will get to know the challenges that are faced by the automotive and avionics industry;
- you will learn and master stochastic analysis for complex real-time systems;
- you will design algorithms to show and understand complex trade-offs in mixed-criticality systems.

**Requirements:**
Courses: Embedded Systems, Hardware/Software Co-Design
Programming: Familiarity with C/C++/Java, Matlab/Mathematica/R

**Interested? Please have a look at http://www.tec.ethz.ch/research.html and drop by for more details!**

## Contacts

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