ETH
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Swiss Federal Institute of Technology Zurich

Institut für Technische Informatik
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Computer Engineering and
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Master Thesis:

# Orchestrate the Mixed-Criticality Melody

## Resource Efficient Composition of Mixed-Criticality Systems

**The Problem:** Complex embedded systems are typically mixed-critical, where functionalities of different *safety* criticalities co-exist. Common examples are airborne software systems, smartcar systems and medical systems. Take the heart peacemaker from medical systems for example: there are important tasks responsible for the heart-rate regulation, and less important tasks which communicate with the health station and report the patient's status. A failure in the heart-rate regulation tasks can be catastrophic while a failure in the communication tasks not. Thus, the guarantees we make for such systems should respect their mixed-criticality nature, i.e. higher assurance for more critical tasks. One common approach is to over-provision resources to more critical tasks for better guarantees.

Furthermore, due to the scale and complexity of mixed-criticality systems, they are often designed compositionally: subsystems are designed independently and integrated later as a whole. Different subsystems can have different features, e.g. criticalities and scheduling policy. As a result, for some subsystems the resources may be over-provisioned while for others not. The over-provisioned resources for one subsystem could be explored to guarantee other subsystems, yielding tighter system designs.

**The Thesis:** In this thesis, the student will design real-time interfaces for mixed-criticality systems, such that the resource requirements for tasks of different criticality levels in each subsystem can be properly captured. To this end, theoretical analysis needs to be performed to determine the subsystem schedulability under the resource interface and the corresponding scheduling policy. The student will examine a set of scheduling policies in this setting.

In addition, the designed resource interface should alow efficient resource sharing among different subsystems. The student will explore: 1) how to "orchestrate" different subsystems to work together; and 2) how to aggregate the real-time interfaces of different subsystems, such that the global resource interface to the processor can be derived.

With the techniques to be proposed, the ultimate goal is to achieve compositional resource sharing for mixed-criticality systems.

**Requirements:**
Courses: Embedded System
Programming: C/C++ Java
Strong Interest in Theoretical Analysis and Algorithm Design

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

## Contacts

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