In partial fulfillment of the terms for obtaining the PhD degree, Peter Gjøl Jensen will give a lecture on the following subject:

**Efficient Analysis and Synthesis of Complex Quantitative Systems**

on Friday 22\textsuperscript{nd} of June 2018, 13:00, in room 0.2.13 at Selma Lagerlöfs Vej 300

**Abstract:**
From toasters to space-stations, computerized technology is pervasive in modern technology and society, therefore the need for truly correct, safe and optimal control algorithms is higher than ever. Techniques like model checking and synthesis have long promised, and to some extend delivered, correctness and optimality guarantees in limited and highly critical application areas like software for satellites, medical devices or powerplants. Common for many of the application areas is the criticality of timing; airbags, pacemakers and traffic-lights have timing constraints that should never be violated.

In this thesis, we attempt to improve the applicability of model checking and synthesis methods for timed systems by attacking three different inhibiting factors to their applicability; 1) speed of computation, 2) what can be synthesized and 3) tool integration and interaction.

To improve on the speed of computation, we attack what is called the state-space explosion problem and present alternatives for the state-space representation. We attack this problem by developing novel algorithms and datastructures for the reduction of memory and time consumption.

To increase the applicability of synthesis, we present a semi-algorithm for parameter synthesis for Timed Automata, extendable to more expressive formalisms. We also demonstrate an over/under-approximate technique for the synthesis of Metric Interval Temporal Logic specifications and show the methods feasibility on a series of examples. As a final contribution to the topic, we present a tool which encompass both ideas from the formal methods community and the machine intelligence community, providing both safe and optimal control synthesis.

In the topic of tool integration, we extend the tool Uppaal to facilitate interoperability with other tools. We show that integration between Uppaal and a plethora of other tools is possible via the Function Mockup Interface standard and demonstrate that Uppaal can be used as the driving tool for a so-called co-simulation. We also present a case-study using externally defined components, such as an ARM-processor emulator, in a classical model checking context.

Members of the assessment committee are Professor Doctor Jaco Van de Pol, University of Twente, Professor Saddek Bensalem, Université Grenoble Alpes, and Associate Professor Bent Thomsen, Aalborg University. Professor Kim Guldstand Larsen and Professor MSO. Jiří Srba are Peter Gjøl Jensen’s supervisors. Moderator Associate Professor Brian Nielsen.

All interested parties are welcome. After the defense the department will be hosting a small reception in cluster 1.