Schweizerische Gesellschaft für Automatik
Association Suisse pour l'Automatique
Swiss Society for Automatic Control

www.sga-asspa.ch

Invitation to the Annual SGA Meeting and Awards Ceremony "Förderpreis 2022"

Guests are welcome!

Date	**Thursday, February 9th, 2023, starting at 15:00**
Location	OST Ostschweizer Fachhochschule Oberseestrasse 10, CH-8640 Rapperswil Building 4, Room 4.112/113 Campus Rapperswil-Jona
Directions	see page 4
Registration	Please register before January, 31th, via email to sekretariat@sga-asspa.ch

PROGRAMME

15:00 **Welcome**
Markus Kottmann, President SGA

Talks of the Awardees

15:05 **Regelungsoptimierung Ölkreislauf**

Dominique Torti, FHNW Hochschule für Technik (Bachelor)

Turbolader verbessern den Wirkungsgrad und die Leistung von vielen Motoren weltweit. Die Firma Accelleron entwickelt solche Turbolader in Baden. Dazu benötigt sie Prüfstände, auf denen eine ganze Reihe an Tests durchgeführt werden können. Ein Turboladerprüfstand ist eine Anlage zum Betreiben eines Turboladers unter motorähnlichen Betriebsbedingungen. Bestandteil davon ist ein Versorgungssystem zur Ölschmierung der Gleitlager im Turbolader. Dessen Temperaturregelung bietet zurzeit keine befriedigende Leistung. In dieser Arbeit wird ein Regler entwickelt, der die besonderen Ansprüche des Systems erfüllen kann. Die Totzeit durch die lange Ölzuleitung zum Prüfstand wird durch einen Smith Predictor beherrschbar gemacht. Dessen Vorhersagemodelle basieren auf Zustandsraummodellen der Anlage und ermöglichen ein Simulieren des Reglers in der Simulation. Es wird gezeigt, dass der Sollwert in einem Bruchteil der Zeit erreicht werden kann, bei gleichzeitiger Erhöhung der Robustheit.

15:30 **awards ceremony Bachelor**

15:35 **Minimum-race-time Energy Allocation Strategies for the Hybrid-electric Formula 1 Power Unit**

Daniele Buccheri, Institute for Dynamic Systems and Control, ETH Zurich (Master)

Nowadays, the Formula 1 propulsion system is a hybrid electric powertrain, with an energy storage system, an electric motor for kinetic energy recuperation and extra boosting, and an electrified turbocharger. Due to the complex topology, the multiple energy sources, and the convoluted power flows, optimizing the energy management for the Formula 1 race car requires the use of a rigorous numerical optimization approach. While several model-based and space-discretized frameworks have already been published for the optimization of a single lap, considering the whole race horizon with the same approach results in optimization problems too big and complex to be solved reliably. Therefore, in this master thesis, we propose a data-driven and lap-discretized approach to optimize the energy management of a whole Formula 1 race. The method is based on the assumption that the energy allocation strategy of each lap can be optimized separately from the optimal energy deployment in the same lap. First, we present the whole framework, going into details of each of its components: A minimum-lap-time non-linear program, a map fitting approach based on artificial neural networks to capture the achievable lap time as a function of the allocated energy, and a minimum-race-time non-linear program. Using the framework, we compare the optimal energy allocation strategy with a simple heuristic, and we optimize the optimal race fuel load, showcasing the potential improvement in race time. Then, we apply the developed non-linear program to a shrinking-horizon model predictive control loop, showing that it can be used in real time to correctly react to disturbances that commonly occur during a race. Finally, we re-formulate the optimizer to obtain a stochastic model predictive control, to study how much time can be gained by including a probabilistic knowledge of future disturbances in the model.

16:00 **award ceremony Master 1**

16:05 **Learning-Based Model Predictive Coverage Control**

Rahel Rickenbach, Institute for Dynamic Systems and Control, ETH Zurich (Master)

In the field of coverage control, multiple agents are controlled to cover a predefined area optimally with respect to a given density function. This allows for a variety of possible applications. An example is the repositioning of self-driving taxis due to population density, providing a faster and more environmentally friendly service. While famous coverage solutions rely on the Lloyd algorithm for convergence to an optimal configuration, guarantees are mainly provided for point masses having the dynamics of a single integrator. In this thesis, the combination of coverage control with a model predictive controller is investigated. Allowing the consideration of more advanced dynamics and simplifying cooperation with the introduction of collision avoidance constraints. Additionally, different extensions of the hierarchical coverage control structure are analyzed and their convergence to an optimal configuration is shown. One of them is the combination with an unknown environment, where the density function information, representing the available knowledge of the environment, is missing at the beginning of the coverage task. Enabling the agents to take measurements on their current locations, Bayesian Linear Regression and Gaussian Process are used to learn the density function as part of the coverage task. Results in simulation and on the CRS hardware are presented. Furthermore, an outlook for future work is given.

16:30 **awards ceremony Master 2**

16:35 **Lab visit**

17:05 **Apéro and Networking**

ca. 18:00 **End of the Event**

OST
Ostschweizer
Fachhochschule

Campus Rapperswil-Jona

Situationsplan

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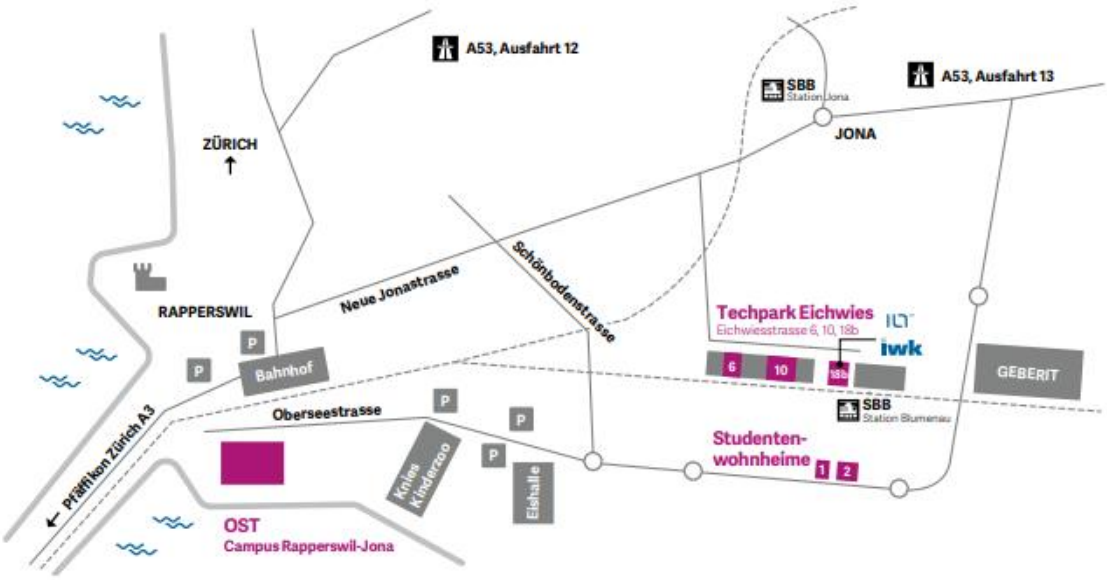
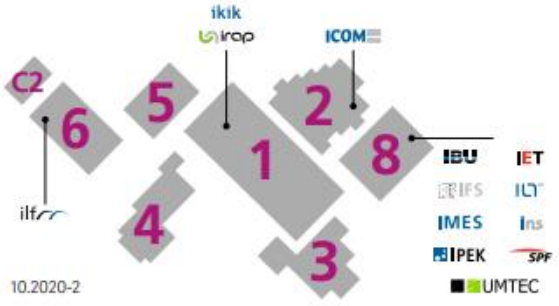
Öffnungszeiten (während der Unterrichtszeit)
Montag bis Freitag 07.40 – 15.30 Uhr

Angestellte und
Gäste auf Voranmeldung 15.30 – 17.00 Uhr





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3 Hörsaalgebäude
4 Verwaltungsgebäude
Empfang
Aula
Mensa
5 Foyergebäude
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6 Schulgebäude See
8 Forschungszentrum
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