



# Two Week TEMPO Summer School (3 ECTS) on Numerical Optimal Control and Embedded Optimization

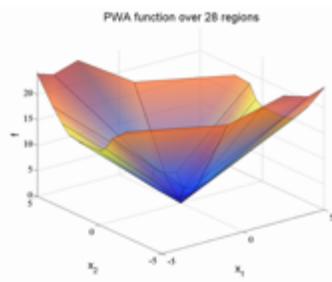
July 27 - August 7, 2015

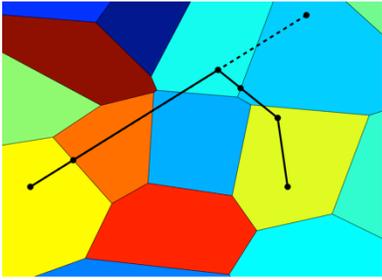
University of Freiburg

For industrial and academic researchers, in particular PhD and master students in engineering, mathematics, physics, and computer science.

The aim of this intensive two week course is to give both theoretical background and hands-on practical knowledge with computational tools for optimal control and embedded optimization.

**Content:** The course covers all topics relevant for the formulation and practical solution of optimal control problems (OCP) with a focus on embedded optimization algorithms. It starts with an introduction into convex optimization with a particular focus on solution algorithms for quadratic programming (QP) problems arising in optimal control and embedded optimization. We also treat methods for general nonlinear optimal control problems such as direct transcription methods (multiple shooting and collocation) and dynamic programming, and methods tailored to model predictive control (MPC) such as explicit MPC, code generated MPC solvers, online active set methods, sparsity exploitation and fast gradient methods.





All lecture topics are accompanied by intensive computer exercises, for which we use the MATLAB environment together with the optimization tools YALMIP, MPT Toolbox, ACADO Toolkit, FORCES, FiOrdOs, qpOASES, qpDUNES. Towards the end of the course, each participant will also start to work on a self-chosen application problem and the results will be presented in a short public presentation on the last day of the course.

**Prerequisites, Workload and Evaluation:** The course is self contained and can be followed by all quantitative scientists with solid mathematical background (calculus and linear algebra) and knowledge of feedback control systems. It is recommended for both industrial and academic practitioners of control and optimization as well as for master and PhD students of engineering, computer science, mathematics, and physics. The total workload is 90 hours including lectures, project work and self-study, and the course gives 3 ECTS credits. The final course evaluation is based 50% on the written exam and 50% on the projects. A certificate of attendance can be given to participants not wishing to participate in the exam and/or project.



**Location and Schedule:** The course takes place from Monday, July 27, 2015 to Friday, August 7, 2015, from 9:00-18:00, in the main historical university building in the city center of Freiburg (Kollegiengebäude I, HS 1015, Platz der Universität 3 , D-79098 Freiburg). In the weekend, an optional excursion into the black forest is foreseen. The written exam takes place on Monday, August 3, 9:00-10:30. The final project presentations take place on Friday, August 7.

**Registration:** Participation in the course is limited to 60 places. A cost contribution of 300 Euro to cover coffee breaks and social events will be required by external participants. To apply for participation please fill in the form at <http://goo.gl/forms/viB7v5Qi1r> before June 1, 2015.

**Organizers and teachers:** Prof. Dr. Moritz Diehl (Univ. Freiburg), Prof. Dr. Colin Jones (EPF Lausanne), Rien Quirynen (KU Leuven), Dimitris Kouzoupis and Robin Verschueren (Univ. Freiburg). External speakers will comprise Michal Kvasnica (Slovak Technical University), Alexander Domahidi (ETH Zurich and EMBOTECH), and Hans Joachim Ferreau (ABB). Support by the EU via the ITN TEMPO (607957, <http://www.itk.ntnu.no/tempo/start> ) is gratefully acknowledged.

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