

Multi-Parametric Optimization & Control – a *guided tour*

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Multi-parametric optimization provides a complete map of solutions of an optimization problem as a function of unknown but bounded parameters of a system, in a computationally efficient manner, without exhaustively enumerating the entire parameter space. In a Model-based Predictive Control (MPC) framework, multi-parametric optimization can be used to obtain the governing control laws of the system – the optimal control variables as an explicit function of the measurements. The main advantage of this approach is that it reduces repetitive on-line control and real-time optimization to simple function evaluations, which can be implemented on simple computational hardware, such as a microchip, thereby opening avenues for many applications in energy, chemical, automotive and biomedical equipment, devices, and systems.

In this presentation, we will first provide a progress report of the key historical developments in multi-parametric optimization and control. We will then describe PAROC, a systematic framework and prototype software system, which allows for the representation, modelling and solution of integrated design, operation and advanced control problems. Its main computational engine, the Parametric Optimization toolbox, will be highlighted for classes of mixed continuous and integer optimization models. Finally, we will discuss the integration capabilities for design, and moving horizon scheduling and control, along with applications in sustainable energy systems, smart manufacturing and process intensification.

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Professor Pistikopoulos is the Director of the Texas A&M Energy Institute and holds the Dow Chemical Chair in the Artie McFerrin Department of Chemical Engineering at Texas A&M University. He was a Professor of Chemical Engineering at Imperial College London, UK (1991-2015) and the Director of its Centre for Process Systems Engineering (2002-2009). He holds a Ph.D. degree from Carnegie Mellon University and he worked with Shell Chemicals in Amsterdam before joining Imperial. He has authored/co-authored over 500 major research publications in the areas of modelling, control and optimization of process, energy and systems engineering applications, 15 books and 3 patents. He is a co-founder of Process Systems Enterprise (PSE) Ltd, a Fellow of AIChE and IChemE and the current Editor-in-Chief of Computers & Chemical Engineering. In 2007, Prof. Pistikopoulos was a co-recipient of the prestigious MacRobert Award from the Royal Academy of Engineering; in 2012, he was the recipient of the Computing in Chemical Engineering Award of CAST/AIChE; and in 2019, he received the Sargent Medal from IChemE. He received the title of Doctor Honoris Causa from the University Politehnica of Bucharest in 2014, and from the University of Pannonia in 2015. In 2013, he was elected Fellow of the Royal Academy of Engineering in the UK.