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

In this presentation, we will first provide a historical progress report of the key developments in multi-parametric programming and control. We will then describe PAROC, a prototype software system which allows for the representation, modelling and solution of integrated design, operation and advanced control problems. Its main features include: (i) a high-fidelity dynamic model representation, also involving global sensitivity analysis, parameter estimation and mixed integer dynamic optimization capabilities; (ii) a suite/toolbox of model approximation methods; (iii) a host of multi-parametric programming solvers (POP - parametric Optimization) for mixed continuous/integer problems; (iv) a state-space modelling representation capability for scheduling and control problems; and (v) an advanced control toolkit for multi-parametric/explicit MPC and moving horizon reactive scheduling problems. Algorithms that enable the integration capabilities of the systems for design, scheduling and control are presented along with applications in sustainable energy systems, process intensification, smart manufacturing and personalized healthcare engineering.

PIZZA WILL BE SERVED AT 4:00 P.M.