Model-based Optimizing Control group (MOBOCON)
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Mission
Fast numerical methods for real-time feedback control of large-scale real-world processes (NMPC: Nonlinear Model Predictive Control)

Challenges
- Large-scale nonlinear processes (e.g., parabolic PDEs)
- With difficult boundary conditions (e.g., time-periodicity)
- With switches in the dynamics
- That need to be optimized with respect to economic objectives
- That are subject to uncertainties

Current projects

Dual Control for NMPC
- NMPC for dynamic systems with uncertain parameters and states
- Goal of Dual Control:
  - Balance control performance and information gain
- Approach: Multi-objective optimal control with optimum experimental design in real-time

Newton-Picard NMPC
- Goal: Real-time optimization of parabolic PDEs
- Numerical method: Two-grid Newton-Picard Inexact SQP
- Approximate derivative matrices on coarse grid
- Split up iterations in feedback and preparation phase
- In feedback phase: Only coarse grid operations needed
  - Short feedback delay

Backward Step Control
- Globalization for Newton-type methods
- Simple and efficient numerical implementation
- Analysis based on infinitesimal Newton-type methods
- Generalized Newton paths
- Convergence proof with a priori estimates on number of iterations
- Guaranteed convergence to end of generalized Newton path

Selected references