Tentative title
Control for Optimization

Tentative synopsis
This course explores the connections between control and optimization methodologies, focusing on the analysis of optimization algorithms as feedback interconnected dynamical systems. It covers both basic and advanced topics in these disciplines, enabling students to understand the deep connections between the two areas. Through selected practical examples and exercises, theoretical concepts – such as algorithm convergence and stability analysis – will be illustrated to demonstrate the potential impact of these connections.

Tenative Program for 15h
Topics in discrete-time linear systems – 4h
Stability and I/O properties
Integral control for linear systems and for uncertain algebraic maps
Passivity and discrete positive realness of dynamical systems and algebraic maps (sector bounds and slope restrictions)
The Lur'e problem
Selected practical examples/exercises (to be reused later)

Basics in convex optimization – 4h
Unconstrained and (linearly) constrained optimzation problems
Gradient method (discrete-time)/Gradient flow (continuous-time)
Proximal minimization method
Primal-dual method
ADMM for resource allocation

Optimization algorithms as controlled (algebraic) nonlinearities – 4h
Gradient method convergence
ADMM convergence
Consensus algorithm as a controlled static map

Distributed optimization – 3h
"Gradient-Tracking" for consensus optimization
"Tracking-ADMM" for resource allocation