Modeling, Simulation, and Optimization

Aims: Knowledge and abilites in model building, simulation and optimization of dynamic systems in physics and technics. The mathematical representation of the underlying physical principles are ordinary or partial differential equations or differential-algebraic equations (DAE).

Prerequisites: Dynamics, differential equations, matrix analysis

Contents: Description of principles of modeling the most important physical and technical systems: mechanical systems, electro-dynamical systems, thermo-fluidic systems. Most important is the representation of the analogies of the mathematical formlations and the underlying physical principles. Examples are mechanical vibrations, multi-body modeling, robotic modeling, convection and diffusion models, acoustic models. Development of system identification and model validation techniques.

Description of the solution methods for the developed model equations: one-step and multi-step methods, step-size control, stiff equations, discretization, finite differences and finite elements, differential-algebraic systems of index 1 and index 2. Treatment of initial and boundary value problems.

Description of the most important optimization methods for finite and infinite dimensional systems: parameter optimization and optimal control techniques for dynamical systems. Linear, quadratic and nonlinear optimization, especially sequential quadratic programs; direct and indirect shooting techniques.

Credits: 4

Location and Time: W–1.07, Thu 4–7 pm

Examination: written (90 min), assessment by marks

Lecturer: Dr. Dieter Kraft