



Module	Optimal Control
Responsibility	Prof. Dr.-Ing. Rolf Findeisen
Contents	<p>The module provides an introduction to the formulation, theory, solution, and application of optimal control theory/dynamic optimization. The students are enabled to formulate and solve optimal control problems appearing in many applications spanning from medicine, process control up to systems biology. Besides the theoretical basis numerical solution approaches for optimal control problems are provided.</p> <p>Covered Topics:</p> <ul style="list-style-type: none"> • Static optimization • Numerical algorithms • Dynamic programming, principle of optimality, Hamilton-Jacobi-Bellman equation • Variational calculus, • Pontryagin maximum principle • Numerical solution of optimal control problems • Infinite and finite horizon optimal control, LQ optimal control • Model predictive control • Game theory • Application examples from various fields such as chemical engineering, economics, aeronautics, robotics, biomedicine, and systems biology
Teaching	Lecture and project
Work Load	Time of attendance - Lecture 2 h / week - Exercise 1 h / week
Autonomous work	preparation of project work/report and exam, postprocessing of lectures
Examination	Oral test at the end of the course and project report
Credits	5 Credit points = 150 h (42 h time of attendance, 108 h autonomous work)
Availability	Every winter term
Duration	One term

Module Optimal Control

Recommended
literature

- [1] R. Bellman. Dynamic Programming. Princeton University Press, Princeton, New Jersey, 1957.
 - [2] L.D. Berkovitz. Optimal Control Theory. Springer-Verlag, New York, 1974.
 - [3] D.P. Bertsekas. Dynamic Programming and Optimal Control, volume 1. Athena Scientific Press, Belmont, MA, 2 edition, 2000.
 - [4] D.P. Bertsekas. Dynamic Programming and Optimal Control, volume 2. Athena Scientific Press, Belmont, MA, 2 edition, 2000.
 - [5] T. Binder, L. Blank, H.G. Bock, R. Burlisch, W. Dahmen, M. Diehl, T. Kronseder, W. Marquardt, J.P. Schlöder, and O. von Stryk. Introduction to model based optimization of chemical processes on moving horizons. In M. Groetschel, S.O. Krumke, and J. Rambau, editors, Online Optimization of Large Scale Systems: State of the Art, pages 295–339. Springer, 2001.
 - [6] A. E. Bryson and Y.-C. Ho. Applied Optimal Control. Ginn and Company, Waltham, Massachusetts, 1969.
 - [7] O. Föllinger. Optimierung dynamischer Systeme. Oldenburg Verlag, München, 1988.
 - [8] H.P. Geering. Optimale Regelung. IMRT Press, ETH-Zürich, 1999.
 - [9] L.M. Hocking. Optimal Control. An Introduction to the Theory with Applications. Oxford Applied Mathematics and Computing Science Series. Oxford University Press, Oxford, 1991.
 - [10] D.E. Kirk. Optimal Control Theory – An Introduction. Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1970.
 - [11] J. Macki and A. Strauss. Introduction to Optimal Control Theory. Undergraduate Texts in Mathematics. Springer, 1982.
 - [12] R. Pytlak. Numerical Methods for Optimal Control Problems with State Constraints. Lecture Notes in Mathematics. Springer, Berlin, 1999.
 - [13] J.L. Troutmann. Variational Calculus and Optimal Control. Undergraduate Texts in Mathematics. Springer, Berlin, 1991.
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