

# PUBLICATIONS

Helmut Maurer

## BOOK and EDITED VOLUMES

1. Advances in Mathematical Modeling, Optimization and Optimal Control (J.-B. Hiriart-Urruty, A. Korytowski, H. Maurer, M. Szymkat, Eds.), Springer Optimization and Its Application, Vol. 109, Springer International Publishing, Switzerland, 2016.
2. N. P. OSMOLOVSKII AND H. MAURER, Applications to Regular and Bang-Bang Control: Second-Order Necessary and Sufficient Optimality Conditions in Calculus of Variations and Optimal Control, SIAM Advances in Design and Control, Vol. DC 24, SIAM Publications, Philadelphia, 2012.
3. New Approaches in Dynamic Optimization to Assessment of Economic and Environmental Systems (H. Maurer, T. Palokangas and A. Tarasyev, Eds.), Special Issue of Applied Mathematics and Computation, Vol. 204 (2), pp. 515–643 (2008).

## BOOK CHAPTERS

4. N.P. OSMOLOVSKII AND H. MAURER, Second-Order Optimality Conditions for Broken Extremals and Bang-Bang Controls: Theory and Applications, In: Advances in Mathematical Modeling, Optimization and Optimal Control, J.-B. Hiriart-Urruty, A. Korytowski, H. Maurer, M. Szymkat (Eds.), Springer Optimization and Its Application, Vol. **109**, pp. 147–201, Springer International Publishing, Switzerland, 2016.
5. H. MAURER, J.J. PREUSS, W. SEMMLER, Policy Scenarios in a Model of Optimal Economic Growth and Climate Change, in : The Oxford Handbook of the Macroeconomics of Global Warming (Lucas Bernard and Willi Semmler, eds.), Chapter 5, pp. 82–113, Oxford University Press, 2015.
6. H. MAURER, J.J. PREUSS AND W. SEMMLER, Optimal control of growth and climate change - Exploration of scenarios, in: Green Growth and Sustainable Development (J. Crespo Cuaresma, T. Palokangas, A. Tarasyev, Eds.), pp. 113–139, Springer, Berlin, 2013.
7. H. MAURER, J.-H.R. KIM AND G. VOSSEN: On a state–constrained control problem in optimal production and maintenance, in: *Optimal Control and Dynamic*

*Games, Applications in Finance, Management Science and Economics*, C. Deissenberg, R.F. Hartl, eds., pp. 289–308, Springer Verlag, 2005.

8. C. BÜSKENS, H. MAURER: Sensitivity analysis and real-time optimization of parametric nonlinear programming problems, in: *Online Optimization of Large Scale Systems* (M. Grötschel, S. O. Krumke, J. Rambau, Eds.), Springer, Berlin, pp. 3–16, 2001.
9. H. MAURER, D. AUGUSTIN: Sensitivity analysis and real-time control of parametric optimal control problems using boundary value methods, in: *Online Optimization of Large Scale Systems* (M. Grötschel, S. O. Krumke, J. Rambau, Eds.), Springer, Berlin, pp. 17–55, 2001.
10. C. BÜSKENS, H. MAURER: Sensitivity analysis and real-time control of parametric optimal control problems using nonlinear programming methods, in: *Online Optimization of Large Scale Systems* (M. Grötschel, S. O. Krumke, J. Rambau, Eds.), Springer, Berlin, pp. 57–68, 2001.
11. D. AUGUSTIN, H. MAURER: Sensitivity analysis and real-time control of a container crane under state constraints, in: *Online Optimization of Large Scale Systems* (M. Grötschel, S. O. Krumke, J. Rambau, Eds.), Springer, Berlin, pp. 69–82, 2001.
12. C. BÜSKENS, H. MAURER: Real-time control of an industrial robot under control and state constraints, in: *Online Optimization of Large Scale Systems* (M. Grötschel, S. O. Krumke, J. Rambau, Eds.), Springer, Berlin, pp. 83–92, 2001.

## REFEREED JOURNAL ARTICLES and CONFERENCE PROCEEDINGS

13. C. SILVA AND H. MAURER, *Optimal control of HIV treatment and immunotherapy combination with control and state delays*, *Optimal Control Applications and Methods*, early view: December 2019 , DOI 10.1002/oca2558
14. F.A. RIHAN, S. LAKSHMANAN AND H. MAURER, *Optimal control of tumour-immune model with time-delay and immuno-chemotherapy*, *Applied Mathematics and Computation*, **353**, 147-165 (2019).
15. U. LEDZEWICZ, H. MAURER AND H. SCHÄTTLER, *Optimal combined radio-and anti-angiogenic cancer therapy*, *J. Optimization Theory and Applications*, **180**, 321–340 (2019).
16. W. SEMMLER, H. MAURER, AND A. BONEN, *An Extended Integrated Assessment Model for Mitigation and Adaptation Policies on Climate Change*, in: *Control Systems and Mathematical Methods in Economics, Essays in honor of Vladimir M.*

Veliov (G. Feichtinger, R.M. Kovacevic, G. Tragler, eds.), Lecture Notes in Economics and Mathematical Systems, Springer 2018.

17. L. GÖLLMANN AND H. MAURER, *Optimal control problems with time-delays: two case studies in biomedicine*, Mathematical Biosciences and Engineering, **15 (5)**, 1137–1154 (2018).
18. M. DO R. DE PINHO, H. MAURER AND H. ZIDANI, Optimal control of a normalized SIMR model with vaccination and treatment, Discrete and Continuous Dynamical Systems - Series B, **28**, 79-99 (2018).
19. F. RODRIGUES, C.J. SILVA, D.F.M. TORRES AND H. MAURER, Optimal control of a delayed HIV model, Discrete and Continuous Dynamical Systems - Series B, **23 (1)**, 443-458 (2018).
20. C.J. SILVA, H. MAURER AND D.F.M. TORRES, Optimal control of a Tuberculosis model with state and control delays, Mathematical Biosciences and Engineering **14(1)**, pp. 321–337 (2017), doi:10.3934/mbe.2017021
21. J. KLAMKA, H. MAURER AND A. SWIERNIAK, Local controllability and optimal control for a model of combined anticancer therapy with control delays, Mathematical Biosciences and Engineering **14(1)**, pp. 195–216 (2017), doi:10.3934/mbe.2017013
22. A. BURTCHEM, H. MAURER AND S. PICKENHAIN, Numerical treatment of the optimal energy control problem of hybrid vehicles, Proceedings of the 55th IEEE Conference on Decision and Control (CDC), Las Vegas, pp. 7377–7383, 2016.
23. C.R. HE, H. MAURER AND G. OROSZ, Fuel consumption optimization of heavy-duty vehicles with grade, wind and traffic information, J. of Computational and Nonlinear Dynamics **11**, 061011-1–06011-12, 2016.
24. C. ROJAS, J. BELMONTE-BEITIA, V.M. PEREZ-GARCIA AND H. MAURER, Dynamics and optimal control of chemotherapy for low grade gliomas: Insights from a mathematical model, Discrete and Continuous Dynamical Systems – Series B, **21**, pp. 1895–1915, 2016.
25. H. MAURER AND M.R. DE PINHO, Optimal Control of Epidemiological SEIR models with  $L^1$ -Objectives and Control–State Constraints, Pacific J. of Optimization **12(2)**, 415–436 (2016).
26. H. MAURER AND W. SEMMLER, Expediting the transition from non-renewable to renewable energy via optimal control, Discrete and Continuous Dynamical Systems, **35 (9)**, 4503–4523 (2015).

27. H. SCHÄTTLER, U. LEDZEWICZ, AND H. MAURER, Sufficient conditions for strong local optimality in optimal control problems with  $L^2$ -type objectives and control constraints, *Discrete and Continuous Dynamical Systems–B*, **19**, No. 8, pp. 2657–2679 (2014).
28. H. MAURER, T. TARNOPOLSKAYA AND N. FULTON, Computation of optimal bang-bang and singular controls in planar collision avoidance, *J. of Industrial and Management Optimization*, **10**, No. 2, pp. 443–460 (2014).
29. L. GÖLLMANN AND H. MAURER, Theory and applications of optimal control problems with multiple time-delays, *J. of Industrial and Management Optimization*, **10**, No. 2, pp. 413–441 (2014).
30. Y. KAYA AND H. MAURER, A numerical method for nonconvex multi-objective optimal control problems, *Computational Optimization and Applications*, **57**, pp. 685–702 (2014); DOI 10.1007/s10589-013-9603-2, 2013.
31. A. BOCCIA, P. FALUGI, H. MAURER AND R.B. VINTER, Free time optimal control problems with time delays, *Proceedings of the 52nd IEEE Conference on Control and Design (CDC 2013)*, Firenze, December 9–12, 520–525, 2013.
32. H. MAURER AND N. OSMOLOVSKII, Second-order conditions for optimal control problems with mixed control-state constraints and control appearing linearly, *Proceedings of the 52nd IEEE Conference on Control and Design (CDC 2013)*, Firenze, IEEE Publications, 514–519, 2013.
33. T. TARNOPOLSKAYA, N. FULTON, H. MAURER, Synthesis of optimal bang-bang control for cooperative collision avoidance for aircraft (ships) with unequal linear speeds, *J. Optimization Theory and Applications*, **155**, pp. 115-144 (2012) (DOI 10.1007/s10957-012-0049-y).
34. H. MAURER, T. TARNOPOLSKAYA AND N. FULTON, Singular controls in optimal collision avoidance for participants with unequal linear speeds, *ANZIAM Journal (EMAC2011)*, C1-C18 (2012).
35. L. FRANEK, M. FRANEK, H. MAURER AND M. WAGNER, A discretization method for the numerical solution of Dieudonné-Rashevsky type problems with application to edge detection within noisy image data, *Optimal Control Applications & Methods* **33**, pp. 276–301 (2012).
36. U. LEDZEWICZ, H. MAURER, H. SCHÄTTLER: Optimal and suboptimal protocols for a mathematical model for tumor anti-angiogenesis in combination with chemotherapy, *Mathematical Biosciences and Engineering*, **8**, pp. 307–328 (2011).

37. B. CHRISTIANSEN, H. MAURER, O. ZIRN, Optimal control of servo actuators with flexible load and Coulombic friction, *European Journal of Control* **17**, pp. 1–11 (2011).
38. H. MAURER AND W. SEMMLER, (2011). A model of oil discovery and extraction, *Applied Mathematics and Computation* **217**, 1163–1169 (2011).
39. B. CHRISTIANSEN, H. MAURER, O. ZIRN, Optimal control of machine tool manipulators, in: *Recent Advances in Optimization and Its Applications in Engineering: The 14th Belgian-French-German Conference on Optimization*, Leuven, September 2009 (M. Diehl, F. Glineur, E. Jarlebring, W. Michels, Eds.), pp. 451–460, Springer Berlin, 2010.
40. U. LEDZEWICZ, H. MAURER, H. SCHÄTTLER, Minimizing tumor volume for a mathematical model of anti-angiogenesis with linear pharmacokinetics, in: *Recent Advances in Optimization and Its Applications in Engineering: The 14th Belgian-French-German Conference on Optimization*, Leuven, September 2009 (M. Diehl, F. Glineur, E. Jarlebring, W. Michels, Eds.) , Leuven, September 2009, pp. 267–276, Springer Berlin, 2010.
41. U. LEDZEWICZ, H. MAURER, H. SCHÄTTLER, On optimal delivery of combination therapy for tumors, *Mathematical Biosciences* **22**, pp. 13–26 (2009).
42. U. LEDZEWICZ, J. MARRIOTT, H. MAURER AND H. SCHÄTTLER, Realizable protocols for optimal administration of drugs in mathematical models for novel cancer treatments, *Mathematical Medicine and Biology* (2009).
43. U. LEDZEWICZ, H. MAURER AND H. SCHÄTTLER, *Bang-bang and singular controls in a mathematical model for combined anti-angiogenic and chemotherapy treatments*, *Proceedings of the Joint IEEE Conference on Decision and Control and 28th Chinese Control Conference*, Shanghai, pp. 2280–2285 (2009).
44. C. BRUNE, H. MAURER AND M. WAGNER, Edge detection within optical flow via multidimensional control, *SIAM J. Imaging Sciences* **2**, pp. 1190–1210 (2009).
45. L. GÖLLMANN, D. KERN AND H. MAURER, Optimal control problems with delays in state and control and mixed control-state constraints, *Optimal Control Applications and Methods* **30**, pp. 341–365 (2009).
46. H. MAURER AND G. VOSSEN, Sufficient conditions and sensitivity analysis for bang–bang control problems with state constraints, *Proceedings of the 23rd IFIP Conference on System Modeling and Optimization*, Cracow, Poland (A. Korytowski, M. Szymkat, Eds.), pp. 82–99, Springer Verlag, Berlin, 2009.

47. N.P. OSMOLOVSKII AND H. MAURER, Second order sufficient optimality conditions for a control problem with continuous and bang-bang control components: Riccati approach, Proceedings of the 23rd IFIP Conference on System Modeling and Optimization, Cracow, Poland (A. Korytowski, M. Szymkat, eds.), pp. 411-429, Springer Verlag, Berlin, 2009.
48. U. LEDZEWICZ, J. MARRIOTT, H. MAURER AND H. SCHÄTTLER, The scheduling of angiogenic inhibitors minimizing tumor volume, J. of Medical Informatics and Technologies, **12**, pp. 23–28 (2008).
49. B. CHRISTIANSEN, H. MAURER AND O. ZIRN, Optimal control of a voice-coil motor with Coulombic friction, Proceedings of the 47th Conference on Decision and Control (CDC), Cancun, Mexico, pp. 1557–1562, December 2008.
50. A. KORYTOWSKI, M. SZYMKAT, H. MAURER AND G. VOSSEN: Optimal control of a fedbatch fermentation process: numerical methods, sufficient conditions and sensitivity analysis, Proceedings of the 47th Conference on Decision and Control (CDC), Cancun, Mexico, pp. 1551–1556, December 2008.
51. H. MAURER AND H.-J. PESCH: Direct optimization methods for solving a complex state-constrained optimal control problem in microeconomics, in: *New Approaches in Dynamic Optimization to Assessment of Economic and Environmental Systems*, Applied Mathematics and Computation, Vol. 204 (2), pp. 568–579 (2008).
52. N.P. OSMOLOVSKII AND H. MAURER: Equivalence of second order optimality conditions for bang–bang control problems. Part 2: Proof, variational derivatives and representations, Control and Cybernetics **36**, pp. 5–45 (2007).
53. G. VOSSEN AND H. MAURER: On  $L^1$ –minimization in optimal control and applications to robotics, Optimal Control Applications and Methods **27**, 301–321 (2006).
54. N.P. OSMOLOVSKII, H. MAURER, Equivalence of second order optimality conditions for bang–bang control problems. Part 1: Main result, Control and Cybernetics, **34**, pp. 927–950 (2005).
55. H. MAURER, C. BÜSKENS, J.-H.R. KIM AND Y. KAYA, Optimization methods for the verification of second-order sufficient conditions for bang-bang controls, Optimal Control Methods and Applications **26**, 129–156 (2005).
56. M. CHYBA, H. SUSSMANN, H. MAURER AND G. VOSSEN, Underwater vehicles: The minimum time problem, Proceedings of the 43rd IEEE Conference on Decision and Control (CDC), Nassau, The Bahamas, IEEE Control Society, 2004.

57. D. LEBIEDZ AND H. MAURER, External optimal control of self-organisation dynamics in a chemotaxis reaction diffusion system, *IEE Systems Biology* **2**, pp. 222–229 (2004).
58. K. MALANOWSKI, H. MAURER AND S. PICKENHAIN, Second order sufficient optimality conditions for state constrained optimal control problems, *Journal of Optimization Theory and Applications* **123**, pp. 594–617 (2004).
59. K. MALANOWSKI, H. MAURER AND S. PICKENHAIN, Second order sufficient conditions for optimal control problems subject to first order state constraints, *Proc. 21st IFIP Conference on System Modeling and Optimization, Sophia Antipolis, July 21–25, 2003*, Marcel Dekker, New York, 2004.
60. J.-H. R. KIM, G. L. LIPPI AND H. MAURER, Minimizing the transition time in lasers by optimal control methods. Single mode semiconductor lasers with homogeneous transverse profile, *Physica D – Nonlinear Phenomena* **191**, pp. 238–260 (2004).
61. H. MAURER AND N. OSMOLOVSKII, Second order sufficient conditions for time-optimal bang-bang control problems, *SIAM J. Control and Optimization* **42**, pp. 2239–2263 (2004).
62. J.-H.R. KIM AND H. MAURER: Sensitivity analysis of optimal control problems with bang-bang controls, *Proceedings of the 42nd IEEE Conference on Decision and Control, Maui, Dec. 9-12, 2003*, IEEE Control Society, pp. 3281–3286, 2003.
63. H. MAURER AND N. OSMOLOVSKII, Quadratic sufficient optimality conditions for bang-bang control problems, *Control and Cybernetics* **32**, pp. 555–584 (2003).
64. T. WITTING, G. TSILIMIS, J. KUTZNER, H. ZACHARIAS, M. KÖLLER AND H. MAURER, Adaptive shaping of high-power broadband femtolaser pulses, *Proceedings of the 4th Intern. Workshop on Adaptive Optics for Industry and Medicine (IWAOIM)*, 2003.
65. H. MAURER AND H.J. OBERLE, Second order sufficient conditions for optimal control problems with free final time: the Riccati approach, *SIAM J. Control and Optimization* **41**, No. 2, pp. 380–401 (2002).
66. J.-H.R. KIM, H. MAURER, YU. ASTROV, M. BODE, AND H.G. PURWINS, High speed switch-on of a semiconductor gas discharge image converter using optimal control methods, *J. of Computational Physics* **170**, 395–414 (2001).
67. D. AUGUSTIN AND H. MAURER, Sensitivity analysis and real-time control of a container crane under state constraints, *Optimization* **49**, 351–368 (2001).

68. D. AUGUSTIN AND H. MAURER, Computational sensitivity analysis for state constrained control problems, *Annals of Operations Research* **101**, 75–99 (2001).
69. K. MALANOWSKI AND H. MAURER, Sensitivity analysis for optimal control problems subject to higher order state constraints, *Annals of Operations Research* **101**, 43–71 (2001).
70. H. MAURER AND H.D. MITTELMANN, Optimization techniques for solving elliptic control problems with control and state constraints: Part 2. Distributed control, *Computational Optimization and Applications* **18**, 141–160 (2001).
71. H.D. MITTELMANN AND H. MAURER, Optimization techniques for solving elliptic control problems with control and state constraints, *J. of Computational and Applied Mathematics* **120**, 175–195 (2000).
72. H. MAURER AND H.D. MITTELMANN, Optimization techniques for solving elliptic control problems with control and state constraints: Part 1. Boundary control, *Computational Optimization and Applications* **16**, 29–55 (2000).
73. C. BÜSKENS AND H. MAURER, SQP–methods for solving optimal control problems with control and state constraints: adjoint variables, sensitivity analysis and real-time control, *J. of Computational and Applied Mathematics* **120**, 85–108 (2000).
74. C. BÜSKENS AND H. MAURER, Nonlinear programming methods for real-time control of industrial robots, *J. of Optimization Theory and Applications* **107**, 505–527 (2000).
75. C. BÜSKENS AND H. MAURER, Real-time control of robots with initial value perturbations using nonlinear programming methods, *Optimization* **47**, 383–405 (2000).
76. D. AUGUSTIN AND H. MAURER, Second order sufficient conditions and sensitivity analysis for optimal multiprocess control problems, *Control and Cybernetics* **29**, 11–31 (2000).
77. D. AUGUSTIN AND H. MAURER: Computational sensitivity analysis of state constrained control problems, In: *Optimization, Dynamics and Economic Analysis, Essays in Honor of Gustav Feichtinger*, Physica Verlag, pp. 12–21 (2000).
78. D. AUGUSTIN AND H. MAURER: An example for computational sensitivity analysis of state constrained control problems, In: *Proceedings of the Fifth International Conference on Parametric Optimization and Related Topics* (Hirabayashi et al., eds.), pp. 25–35, Peter Lang, Frankfurt, 2000.



## SELECTED PUBLICATIONS prior to 2000

79. H. MAURER, Sufficient conditions and sensitivity analysis for economic control problems, *Annals of Operations Research* **88**, 3–14 (1999).
80. K. MALANOWSKI AND H. MAURER, Sensitivity analysis for state constrained optimal control problems, *Discrete and Continuous Dynamical Systems* **4**, 241–272 (1998).
81. H. MAURER, C. BÜSKENS AND G. FEICHTINGER, Solution Techniques for Periodic Control Problems, *Optimal Control Applications and Methods* **19**, 185–203 (1998).
82. C. BÜSKENS AND H. MAURER, Sensitivity analysis and real-time control of nonlinear optimal control problems via nonlinear programming methods, *Proceedings of the 12th Conference on Calculus of Variations, Optimal Control and Applications*, Trassenheide, Germany, 1996, *International Series of Numerical Mathematics* **124**, 185–196, Birkhäuser Verlag, Basel, 1998.
83. W. BOLLWEG, H. MAURER H. KROLL, Numerical prediction of crystal structures by simulated annealing, *Developments in Global Optimization* (I.M. Bonze et al., eds.), pp. 253–288, Kluwer Academic Publishers, Netherlands, 1997.
84. K. MALANOWSKI, C. BÜSKENS AND H. MAURER, Convergence of approximations to nonlinear optimal control problems, *Mathematical Programming with Data Perturbations* (A.V. Fiacco, ed.), *Lecture Notes in Pure and Applied Mathematics*, Vol. **195**, pp. 253–284, Marcel-Dekker, Inc., New York , 1997.
85. H. MAURER AND D. AUGUSTIN, Second order sufficient conditions and sensitivity analysis for the controlled Rayleigh equation, *Proceedings of the International Conference on Parametric Optimization and Related Topics IV*, Enschede, 1995 (J. Guddat, H. Th. Jongen, F. Nožička, G. Still, F. Twilt, eds.), Peter Lang, pp. 245–259 (1996).
86. K. MALANOWSKI AND H. MAURER, Sensitivity analysis for parametric control problems with control–state constraints, *Computational Optimization and Applications* **5**, 253–283 (1996).
87. H. MAURER AND S. PICKENHAIN, Second-order sufficient conditions for control problems with mixed control-state constraints, *J. of Optimization Theory and Applications* **86**, 649–667 (1995).
88. H. MAURER AND H. J. PESCH, Solution differentiability for parametric nonlinear control problems with control-state constraints, *Control and Cybernetics* **23**, 201–227 (1994) (extended version).

89. H. MAURER AND H. J. PESCH, Solution differentiability for parametric nonlinear control problems with control-state constraints, *J. of Optimization Theory and Applications* **86**, 285-309 (1994).
90. H. MAURER AND H. J. PESCH, Solution differentiability for parametric nonlinear control problems, *SIAM Journal on Control and Optimization* **32 (6)**, 1503-1541 (1994).
91. H. MAURER AND M. WIEGAND, Numerical solution of a drug displacement problem with bounded state variables, *Optimal Control Applications & Methods* **13**, 43-55 (1992).
92. H. MAURER AND H.D. MITTELMANN, The non-linear beam via optimal control with bounded state variables, *Optimal Control Applications & Methods* **12**, 19-31 (1991).
93. H. MAURER, First and second-order sufficient optimality conditions for in mathematical programming and optimal control, *Mathematical Programming Study*, **14**, 163-177, 1981.
94. H. MAURER AND F. LEMPIO, Differential stability in infinite-dimensional nonlinear programming, *Applied Mathematics and Optimization* **6**, 139-154 (1980).
95. H. MAURER, Differential stability in optimal control, *Applied Mathematics and Optimization* **5**, 283-295 (1979).
96. H. MAURER AND J. ZOWE, First and second-order necessary and sufficient conditions for infinite-dimensional programming problems, *Mathematical Programming*, **16**, 98-110, (1979).
97. H. MAURER, On the minimum principle for optimal control problems with state constraints, *Rechenzentrum der Universität Münster, Report* **41**, Münster, 1979.
98. H. MAURER, On optimal control problems with bounded state variables and control appearing linearly, *SIAM J. Control and Optimization*, **15**, 345-362, 1977.
99. H. MAURER, Numerical solution of singular control problems using multiple shooting techniques, *J. of Optimization Theory and Applications* **18 (2)**, 235-257 (1976).
100. H. MAURER AND D.W. GILLESSEN, Application of multiple shooting to the numerical solution of optimal control problems with bounded state variables, *Computing* **15**, 105-126 (1975).