

Table of Contents

Abstract	vii
Deutsche Kurzfassung	ix
1 Introduction	1
1.1 Research topic overview	3
1.2 Contributions and outline of the thesis	8
2 Background	11
2.1 A brief review of model predictive control	11
2.2 Stochastic MPC – A conceptual algorithm	14
2.3 Summary	21
3 Computational approaches for linear systems	23
3.1 Linear systems with additive disturbances	24
3.1.1 Problem setup and surrogate model	24
3.1.2 Constraint relaxation and recursive feasibility	27
3.1.3 Stochastic MPC algorithm and closed-loop properties	35
3.1.4 Implementation details and numerical example	43
3.1.5 Discussion and summary	48
3.2 Linear systems with multiplicative disturbance	53
3.2.1 Problem setup	53
3.2.2 SMPC design using finite sample approximations	54
3.2.3 Stochastic MPC algorithm and closed-loop properties	60
3.2.4 Numerical example	64
3.2.5 Discussion and summary	65
3.3 Summary	67
4 Uncertainty and online model adaption	69
4.1 Problem setup	70
4.2 Online identification and state prediction	72
4.3 Adaptive MPC algorithm and closed-loop properties	81
4.4 Numerical example and application in tracking MPC	87
4.5 Discussion and summary	91

5	Stochastic MPC without terminal constraints	95
5.1	Problem setup and conceptual SMPC algorithm	96
5.2	Closed-loop properties of the conceptual algorithm	99
5.3	Stability under approximations and relaxations	102
5.4	Discussion and summary	111
6	Conclusions	113
6.1	Discussion and summary	113
6.2	Outlook	115
A	Stability of deterministic and stochastic system	119
B	Technical proofs	123
B.1	SMPC closed-loop properties	123
B.2	VC-Dimension of the class of linear half-spaces	124
B.3	Persistence of excitation	125
C	Miscellaneous	127
C.1	Explicit solution matrices	127
	Notation	130
	Bibliography	133