

Table of Contents

- Chapter 1 Introduction 1**
 - 1.1 Problem Statement and Motivation 1
 - 1.2 Purpose of This Monograph 3
 - 1.3 Background and Literature Review 4
 - 1.3.1 Rough Terrain Modeling and Estimation 4
 - 1.3.2 Rough Terrain Motion Planning..... 7
 - 1.3.3 Rough Terrain Control..... 11
 - 1.4 Outline of This Monograph..... 13
 - 1.5 Assumptions 13
- Chapter 2 Rough Terrain Mobile Robot Modeling and Estimation... 17**
 - 2.1 Introduction 17
 - 2.2 Robot Kinematic and Force Analysis 18
 - 2.2.1 Robot Kinematic Analysis..... 18
 - 2.2.2 Robot Force Analysis 21
 - 2.3 Terrain Characterization and Identification 24
 - 2.3.1 Equation Simplification..... 27
 - 2.3.2 Sensing and Implementation Issues..... 31
 - 2.4 Results: Terrain Identification 33
 - 2.4.1 Simulation Results..... 33
 - 2.4.2 Experimental Results..... 35
 - 2.5 Wheel-Terrain Contact Angle Estimation 39
 - 2.5.1 Extended Kalman Filter Implementation..... 42
 - 2.6 Results: Wheel-Terrain Contact Angle Identification 44
 - 2.6.1 Simulation Results..... 44
 - 2.6.2 Experimental Results..... 45
 - 2.7 Summary and Conclusions 50
- Chapter 3 Rough Terrain Motion Planning..... 51**
 - 3.1 Introduction 51
 - 3.2 Rough Terrain Motion Planning 52
 - 3.2.1 Step One: Rapid Path Search..... 52
 - 3.2.2 Step Two: Model-Based Evaluation..... 57
 - 3.2.3 Uncertainty in Rough Terrain Motion Planning..... 59

3.2.4. Incorporating Uncertainty in the Rapid Path Search	61
3.2.5. Incorporating Uncertainty in the Model-Based Evaluation....	62
3.3 Simulation Results—Rough Terrain Planning	65
3.4 Rough Terrain Articulated Suspension Configuration Planning	70
3.4.1 Articulated Suspension Configuration Planning Problem Description	70
3.4.2 Mobility Analysis	71
3.4.3 Articulated Suspension Configuration Planning for Enhanced Tipover Stability	72
3.5 Results—Rough Terrain Articulated Suspension Configuration Planning	75
3.5.1 Simulation Results	75
3.5.2 Experimental Results	76
3.6 Summary and Conclusions	79
Chapter 4 Rough Terrain Control	81
4.1 Introduction	81
4.2 Mobile Robot Rough Terrain Control (RTC).....	82
4.3 Wheel-Terrain Contact Force Optimization	84
4.3.1 Optimization Criteria.....	84
4.3.2 Problem Constraints	86
4.4 Results—Rough Terrain Control.....	87
4.4.1 Simulation Results.....	87
4.4.2 Experimental Results.....	92
4.5 Summary and Conclusions	96
Chapter 5 Conclusions and Suggestions for Future Work	97
5.1 Contributions of This Monograph.....	97
5.2 Suggestions for Further Work	98
References.....	101
Index	109

Mobile Robots in Rough Terrain
Estimation, Motion Planning, and Control with
Application to Planetary Rovers

Iagnemma, K.; Dubowsky, S.

2004, XII, 111 p., Hardcover

ISBN: 978-3-540-21968-2