

Second Edition

MOBILE ROBOTS



*Navigation, Control and Sensing,
Surface Robots and AUVs*

Gerald Cook
Feitian Zhang




IEEE PRESS

WILEY

Mobile Robots

David Alan Grier
Donald Heirman
Elya B. Joffe
Xiaoou Li

Mobile Robot

Navigation, Control
and AUVs

Copyright © 2020 by The Institute

Published by John Wiley & Sons,

Published simultaneously in Canada

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage or retrieval system, except as permitted under Section 107 or 108 of the United States Copyright Act of 1976, or in writing either the prior written permission of the publisher or by paying the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 750-4744, or by sending a request to the Publisher for permission should be sent to John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, or by visiting the website <http://www.wiley.com/go/permissions>.

Limit of Liability/Disclaimer of Warranty: While the publisher and author(s) have made every effort in preparing this book, the publisher and author(s) assume no responsibility for any errors or omissions, or for any consequences arising from the use of the information contained in this book.

Gerald Cook

*To my heavenly Father for
lifetime of joy and happ*

*To my wife, Nancy Anne
endeavors throughout m*

Contents

Preface *xi*

About the Author

Introduction 1

	Exercises	68
	References	69
3	Robot Attitude	71
3.1	Introduction	71
3.2	Definition of Yaw, Pitch, and Roll	72
3.3	Rotation Matrix for Yaw	73
3.4	Rotation Matrix for Pitch	74
3.5	Rotation Matrix for Roll	75
3.6	General Rotation Matrix	76
3.7	Homogeneous Transformation	77
3.8	Rotating a Vector	78
	Exercises	83
	References	84
4	Robot Navigation	85

6	Remote Sensing	
6.1	Introduction	171
6.2	Camera-Type Sensors	171
6.3	Stereo Vision	183
6.4	Radar Sensing: Synthesis	183
6.5	Pointing of Range	183
6.6	Detection Sensor i	183
	Exercises	199
	References	200

7	Target Tracking Inc	
7.1	Introduction	203
7.2	Regions of Confide	203
7.3	Model of Target L	203
7.4	Inventory of Detec	203
	Exercises	220

x | *Contents*

10.3	Resolution of Sen
10.4	Precision of Vehic
10.5	Overall Geo-Regis
	Exercise 267
	References 267
11	Dynamics Modelin
11.1	Introduction 26
11.2	Motivation 269
11.3	Full Dynamic Mo
11.4	Hydrodynamic M
11.5	Reduced-Order L
11.6	Computation of S
11.7	Scaling Analysis
11.8	Spiraling Dynamic
11.9	Computation of S

11.9	Computation of \mathbf{C}	
	Exercises	288
	References	289
12	Control of AUVs	
12.1	Introduction	29
12.2	Longitudinal Gliding	
12.2.1	Longitudinal Dynamics	
12.2.2	Passivity-Based Control	
12.2.3	Simulation Results	
12.3	Yaw Angle Regulation	
12.3.1	Problem Statement	
12.3.2	Sliding Mode Control	
12.3.3	Simulation Results	
12.4	Spiral Path Tracking	
12.4.1	Steady Spiral and	
12.4.2	Two Degree-of-Freedom	
12.4.3	Simulation Results	
	Exercises	321
	References	322

