# Contents

#### Preface / xi

#### Introduction/Curricular Themes

Unifying Undergraduate Artificial Intelligence Robotics: Layers of Abstraction over Two Channels / 2 Frederick L. Crabbe

> Teaching AI using LEGO Mindstorms / 8 Simon Parsons and Elizabeth Sklar

Robotics Education for All Ages / 14 Maja J. Mataric

#### **Laboratory Exercises 1: Teaching Localization**

Teaching Robot Localization with the Evolution ER1 / 18 Zachary Dodds, Steven Santana, Brandt Erickson, Kamil Wnuk, Jessica Fisher, and Matt Livianu

> A Tool for Integrating Lisp and Robotics in AI Agents Courses / 24 Frank Klassner

> > Teaching Deliberative Navigation Using the LEGO RCX and Standard LEGO Components / 30 Gary R. Mayer, Jerry B. Weinberg, and Xudong Yu

Teaching Artificial Intelligence with Low-Cost Robots / 35

Lloyd Greenwald and Donovan Artz

#### Hardware/Software 1: Novel platforms

TRIPOD — Computer Vision for Classroom Instruction and Robot Design / 42

Paul Y. Oh

Avoiding the Karel-the-Robot Paradox: A Framework for Making Sophisticated Robotics Accessible / 48 Douglas Blank, Holly Yanco, Deepak Kumar, and Lisa Meeden

The Use of Low-Cost RC Servos in a Robotics Curriculum / 52 Bradley E. Bishop, Jenelle Armstrong Piepmeier, George Piper, Kenneth A. Knowles, Kinleong Ho, and Bryan Hudock

CMRoboBits: Creating an Intelligent AIBO Robot / 57
Manuela Veloso, Scott Lenser, Douglas Vail, Paul Rybski, Nick Aiwazian, and Sonia Chernova

Using Virtual Synergy for Artificial Intelligence and Robotics Education / 63 Sheila Tejada, Andrew Cristina, Ryan O'Hara, and Shahrukh Tarapore

Interfacing Handheld Computers to Mobile Robots / 68

Robert Avanzato

## Designing the Next-Generation Handy Board / 72 Fred G. Martin and George J. Pantazopoulos

### Laboratory Exercises 2: Basic and Advanced AI

A Laboratory Exercise using LEGO Handy Board Robots to Demonstrate Neural Networks in an Artificial Intelligence Class / 77 Susan B. Imberman

Dustbot: Bringing a Vacuum-Cleaner Agent to Life / 82 Debra T. Burhans and Michael Kandefer

> AI and Robotics Labs at the Undergraduate Robotics Laboratory, St. Bonaventure University / 85 Robert M. Harlan

#### **Beyond the Traditional CS Student**

Using Robotics to Introduce AI Topics to a Wider Audience / 89
Susan Eileen Fox

Using Robotics to Motivate Learning in an AI Course for Non-Majors / 93

Andrea Pohoreckyj Danyluk

An Introductory CS Course for Cognitive Science Students / 97

\*\*James B. Marshall\*\*

Learning while Teaching Robotics / 102 Elizabeth Sklar and Amy Eguchi

Interfacing the Public and Technology:
A Web Controlled Mobile Robot / 106
Erin J. Harris, R. Andrew Lamonica, and Jerry B. Weinberg

Designing an Online, Distributed, Project-Based Course in Mobile Autonomous Robotics / 111 Ajinkya Y. Bhave and Alex Kass

> Lego Mindstorms Robotics in a (Very) Small Liberal Arts College / 115 Ellen L. Walker

Videofish: TV Worth Catching / 118 Robin R. Murphy, Hasan Elahi, and William Kearns

Bridging the Gap between Space Robotics Research and Robotics Education / 126 Ayanna Howard and Eva Graham

Integrating Education and Real Research / 129

James Garner, Keith Bennett, William D. Smart, David J. Bruemmer,

Douglas A. Few, and Christine M Roman

#### Assessing Approaches to AI/Robotics Education

Formal Measures of Learning in a Secondary School Mobile Robotics Course / 134 *Illah R. Nourbakhsh, Emily Hamner, Kevin Crowley, and Katie Wilkinson* 

Robot Contest: Promoting Experiential Engineering Education / 141 *Igor M. Verner and David J. Ahlgren* 

#### Teaching with RoboCup / 146 Jacky Baltes, Elizabeth Sklar, and John Anderson

## Hardware/Software 2: System Demonstrations

Using Robot Platforms to Enhance Concept Learning in Introductory Computer Science Courses / 153 Colleen Elizabeth Van Lent

Two Lab Exercises for an Introductory Robotics Class / 156 *Jennifer Kay* 

The Use of "Tell Me, Show Me, and Let Me Do It" in Teaching Robotics / 160

Hadi Moradi and Alireza Bahri

From POPSICLE to CARoL in a Semester / 165 Goran Trajkovski, Darush Davani, Gary Williams, Daniel Stamate, Gleb Gudzenko, and Daniel Bittner

Keeping the Focus on Heuristics: Network Game Agent for Teaching AI / 170 R. Andrew Lamonica, Xudong W. Yu, and Jerry Weinberg

Designing Low-Cost Sensors Compatible with LEGO® Mindstorms<sup>™</sup>
Robotics Invention System<sup>™</sup> / 175
Sorin G. Achim, Florentin Achim, and Calin Achim

### Panel: Future Directions for Hands-on AI Education

Using Robotics to Teach Computer Programming & AI Concepts to Engineering Students / 178 David P. Miller