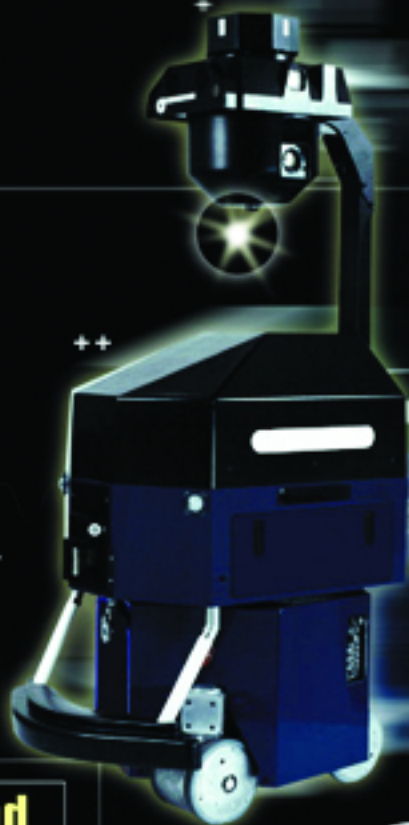




Designing Autonomous Mobile Robots

Inside the Mind of an Intelligent Machine



CD-ROM Included
Contains source code and software tools

John M. Holland



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by John Holland



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Dedication

This book is dedicated to all the employees, board members, stockholders and supporters of Cybermotion over all the years. How I should ever have been lucky enough to work with so many dedicated, talented, intelligent, humorous and tenacious people I shall never know. All of the challenges we faced together have produced these pages, I merely did the typing. In fairness, it must also be dedicated to the long suffering spouses of the “Cyberdogs,” including my own wonderful wife Sheilah.

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Foreword

One of the most exciting challenges a designer can face is that of building a practical autonomous mobile robot. This is as close as we mere mortals can come to producing a living being. Make no mistake; we are talking about very primitive beings, but artificial beings nonetheless. Autonomous robots exist today that can perform complex tasks without human assistance for weeks or even months, but these robots will seem laughably crude in the years to come.

The building blocks for autonomous robots have been readily available for several years. Powerful microprocessors, laser-based sensors (lidar), Ethernet radio communications, video processors, and a host of other subsystems are now priced at levels that permit practical autonomous machines to be built for an exciting range of commercially viable applications. There are even a wide range of simple sensors and actuators that allow the hobbyist to develop small, but sophisticated robots.

The challenge is in understanding how these systems can be made to play together in a coherent and effective way to create a system that is far more than the sum of its parts. If the designer thinks of a new robot design as being laser-guided, or as using GPS navigation, the result will be a design that is inflexible. Such a design may be useful, but it will be not able to grow beyond its initial concept. A stripe following “Automatic Guided Vehicle” is an excellent example of such a design. Autonomous robots are much more robust and interesting beasts.

It is my experience that any good concept will have an intrinsic elegance. A good software and hardware structure is like a snowflake, with each subsystem having the same basic structure as every other subsystem. At the center, a few basic structures hold it all together. Each point of the snowflake will have differences from the others, but will follow the same basic pattern.

Foreword

This is not a book full of complex equations. Everything you need to know about math you learned in geometry class. Nor is this a book about how to build a robot. Instead, this is a book about how to organize a robot design so that building it follows naturally. Robot design is not so much about inventing as it is about rediscovering. The concepts are all familiar; they just need to be placed into a snowflake.

The ideas presented here are based on 18 years of robot design experience. There can be no doubt that others have discovered many of these concepts and given them different names. As I have said, this is about discovery as much as it is about invention. Let me apologize in advance if I have failed to give anyone credit here.

Finally, designing an autonomous robot teaches us many priceless lessons, not the least of which is a deep humility and appreciation of the miracle of the simplest living creatures. Yet for me, there is nothing that compares to the thrill of turning your creation loose to fend for itself! Once you have mastered these concepts, you will be able to approach the design of any complex control system with complete confidence.

What's on the CD-ROM?

Included on the accompanying CD-ROM:

- A full searchable eBook version of the text in Adobe pdf format
- A directory containing the sourcecode for all of the example programs in the book

Refer to the ReadMe file for more details on CD-ROM content.

Section 1:
Background Software Concepts