

Artificial Intelligence for Robotics

Build intelligent robots that perform human tasks using AI techniques



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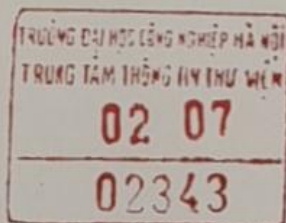
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By Francis X. Govers

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Francis X. Govers



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BIRMINGHAM - MUMBAI

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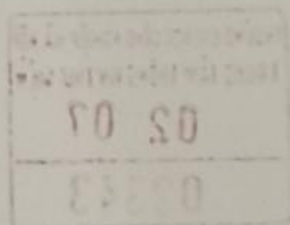


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Who this book is for

This book is designed for intermediate to advanced robotics researchers, professionals, and hobbyists, as well as students who have worked past the basics of robotics and are looking for the next step in their education and skill set.

Readers should be familiar with Python and the Robotics Operating System (ROS), as well as Linux. Advanced math is most definitely not required to get a lot out of this book.

What this book covers

Chapter 1, *Foundations for Learning and AI*, introduces artificial intelligence (AI) and covers the basics of robotics as applied in this book. The chapter also introduces the AI framework used, which is the *Observe-Orchestrate-Decide-Act* (OODA) model, and sets the stage for the rest of the book.

Preface

The objective of this book is to deliver exactly what is on the cover – *Artificial Intelligence for Robotics*. The emphasis is on machine learning techniques applied to ground mobile robots. The book starts with professional robot design principles that have been scaled down for smaller robot projects. The AI section begins with convolutional neural networks for object recognition and continues with reinforcement learning and genetic algorithms. The robot gets a voice and learns to tell jokes using AI-based voice recognition that can discern user intent. The book introduces a novel way to navigate without a map using a literal divide and conquer program that uses the upper part of the room to remember paths, and the lower part to avoid obstacles. The book demonstrates how path planning, decision trees, object classification, and navigation are all part of the same problem set. We finish by giving the robot an artificial personality. The final chapter concludes with thoughts on the future of robots and gives advice on robotics as a career.

The entire book is built around a single fun example task, which is to design and build a robot that can pick up toys in an indoor, unstructured environment. As you will learn, this project is anything but easy.

Who this book is for

This book is designed for intermediate to advanced robotics researchers, professionals, and hobbyists, as well as students who have worked past the basics of robotics and are looking for the next step in their education and skill set.

Readers should be familiar with Python and the **Robotics Operating System (ROS)**, as well as Linux. Advanced math is most definitely not required to get a lot out of this book.

What this book covers

Chapter 1, *Foundation for Robotics and AI*, introduces artificial intelligence (AI) and covers the basics of robotics as applied in this book. The chapter also introduces the AI framework used, which is the **Observe-Orient-Decide-Act (OODA)** model, and soft real-time control.

Chapter 2, *Setting Up Your Robot*, covers the robot architecture, ROS, and setting up the software and hardware, including the construction of the robot example for the book.

Chapter 3, *A Concept for a Practical Robot Design Process*, introduces a simplified systems approach to robot design that combines use cases (from systems engineering) and storyboards (from Agile development) to give the reader a structure and a process to use when solving problems with robots and AI.

Chapter 4, *Object Recognition Using Neural Networks and Supervised Learning*, teaches how to build an artificial neural network. Readers will learn the basics of image recognition as well as the training and evaluation of neural networks using Keras and Python.

Chapter 5, *Picking Up the Toys*, introduces techniques that allow the robot to learn for itself how to use its robot arm. The key technique is to have a mechanism for the robot to score how well it does. We explore reinforcement learning and dive into Genetic Algorithms.

Chapter 6, *Teaching the Robot to Listen*, We develop on top of a voice-based command system, a type of digital assistant that uses AI techniques to understand words and divine the intent of the speaker. Basic concepts of speech recognition and natural language processing are introduced, such as context, knowledge bases, intent recognition, and sentence reconstruction. We teach the robot to both tell and understand knock-knock jokes.

Chapter 7, *Avoiding the Stairs*, helps the readers understand robot navigation, including SLAM. It will help you navigate the robot using a combination of two techniques: Floor Finding for obstacle avoidance, and Neural Network Image recognition for learned navigation without a map.

Chapter 8, *Putting Things Away*, covers path planning, decision trees, classification techniques, wave front, the A* (A star) and D* (D star) algorithms, and node-based planners.

Chapter 9, *Giving the Robot an Artificial Personality*, describes simulation and Monte Carlo modeling, the Robot Emotion Engine, the Human Emotion Model, and integrating personality rules into a chatbot-based conversation engine.

Chapter 10, *Conclusions and Remarks*, has some words about the future of AI and robotics, as well as advice about robotics as a career.