



Learning ROS for Robotics Programming - Second Edition

By Enrique Fernández, Luis Sánchez Crespo, Anil Mahtani, Aaron Martínez

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Your one-stop guide to the Robot Operating System

About This Book

- Model your robot on a virtual world and learn how to simulate it
- Create, visualize, and process Point Cloud information
- Easy-to-follow, practical tutorials to program your own robots

Who This Book Is For

If you are a robotic enthusiast who wants to learn how to build and program your own robots in an easy-to-develop, maintainable, and shareable way, this book is for you. In order to make the most of the book, you should have a C++ programming background, knowledge of GNU/Linux systems, and general skill in computer science. No previous background on ROS is required, as this book takes you from the ground up. It is also advisable to have some knowledge of version control systems, such as svn or git, which are often used by the community to share code.

What You Will Learn

- Install a complete ROS Hydro system
- Create ROS packages and metapackages, using and debugging them in real time
- Build, handle, and debug ROS nodes
- Design your 3D robot model and simulate it in a virtual environment within Gazebo
- Give your robots the power of sight using cameras and calibrate and perform computer vision tasks with them
- Generate and adapt the navigation stack to work with your robot
- Integrate different sensors like Range Laser, Arduino, and Kinect with your

robot

- Visualize and process Point Cloud information from different sensors
- Control and plan motion of robotic arms with multiple joints using MoveIt!

In Detail

If you have ever tried building a robot, then you know how cumbersome programming everything from scratch can be. This is where ROS comes into the picture. It is a collection of tools, libraries, and conventions that simplifies the robot building process. What's more, ROS encourages collaborative robotics software development, allowing you to connect with experts in various fields to collaborate and build upon each other's work.

Packed full of examples, this book will help you understand the ROS framework to help you build your own robot applications in a simulated environment and share your knowledge with the large community supporting ROS.

Starting at an introductory level, this book is a comprehensive guide to the fascinating world of robotics, covering sensor integration, modeling, simulation, computer vision, navigation algorithms, and more. You will then go on to explore concepts like topics, messages, and nodes. Next, you will learn how to make your robot see with HD cameras, or navigate obstacles with range sensors. Furthermore, thanks to the contributions of the vast ROS community, your robot will be able to navigate autonomously, and even recognize and interact with you in a matter of minutes.

What's new in this updated edition? First and foremost, we are going to work with ROS Hydro this time around. You will learn how to create, visualize, and process Point Cloud information from different sensors. This edition will also show you how to control and plan motion of robotic arms with multiple joints using MoveIt!

By the end of this book, you will have all the background you need to build your own robot and get started with ROS.

Style and approach

This book is an easy-to-follow guide that will help you find your way through the ROS framework. This book is packed with hands-on examples that will help you program your robot and give you complete solutions using ROS open source libraries and tools.

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- Rank: #853279 in eBooks
- Published on: 2015-08-18
- Released on: 2015-08-18
- Format: Kindle eBook

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Editorial Review

About the Author

Enrique Fernandez

Enrique Fernandez has a PhD in computer engineering from the University of Las Palmas de Gran Canaria and is a senior robotics engineer currently working at Clearpath Robotics, Inc. He did his MSc master's thesis in 2009 on SLAM. Enrique addresses the problem of path planning for autonomous underwater gliders (AUGs) in his PhD thesis, which was presented in 2013. During that period, he also worked on Computer Vision, AI, and other robotics topics, such as inertial navigation systems and Visual SLAM at the CIRS/ViCOROB Research Lab of the University of Girona for AUVs. He also participated in the Student Autonomous Underwater Challenge, Europe (SAUC-E) in 2012 and collaborated in the 2013 edition; in the 2012 edition, he was awarded a prize. After his PhD, Enrique joined PAL Robotics in June 2013 as a senior robotics engineer in the Autonomous Navigation department. There, he developed software for REEM, REEM-C, and mobile-based robots and also for corresponding projects, such as Stockbot, using the ROS framework intensively. He worked on motion planning (path planning and control for mobile robots), robot localization, and SLAM. Recently, in 2015, he joined Clearpath Robotics, Inc. to work as a senior autonomy developer on SLAM, within the Autonomy department. From an academic perspective, Enrique has published several conference papers and publications, two of them on the International Conference of Robotics and Automation (ICRA), in 2011. He is also an author of chapters of a few books and a previous book about ROS, Learning ROS for Robotics Programming by Packt Publishing. His MSc master's thesis was about the FastSLAM algorithm for indoor robots using a SICK laser scanner and the wheel odometry of a Pioneer differential platform. His PhD thesis contributed path planning algorithms and tools for AUGs. He also has experience with electronics and embedded systems such as PC104 and Arduino. His background covers SLAM, Computer Vision, path planning, optimization, and robotics and artificial intelligence in general.

Luis Sanchez Crespo

Luis Sanchez Crespo completed his dual master's degree in electronics and telecommunication engineering from the University of Las Palmas de Gran Canaria. He has collaborated with different research groups at the Institute for Technological Development and Innovation (IDETIC), the Oceanic Platform of Canary Islands (PLOCAN), and the Institute of Applied Microelectronics (IUMA), where he actually researches the imaging of super-resolution algorithms. His professional interests lie in computer vision, signal processing, and electronic design applied to robotics systems. For this reason, he joined the AVORA team, a group of young engineers and students working on the development of underwater autonomous vehicles (AUVs) from scratch. In this project, Luis has started developing acoustic and computer vision systems, extracting information from different sensors, such as hydrophones, sonar, and cameras. With a strong background gained in marine technology, Luis cofounded Subsea Mechatronics, a young start-up, where he works on developing remotely operated and autonomous vehicles for underwater environments. Here's what Dario Sosa Cabrera, a marine technologies engineer and entrepreneur (and the cofounder and maker of LPA Fabrika: Gran Canaria Maker Space) has to say about Luis: "He is very enthusiastic and an engineer in

multiple disciplines. He is responsible for his work. He can manage himself and can take up responsibilities as a team leader, as was demonstrated at the SAUC-E competition, where he directed the AVORA team. His background in electronics and telecommunications allows him to cover a wide range of expertise from signal processing and software, to electronic design and fabrication." Luis has participated as a technical reviewer for the previous version of Learning ROS for Robotics Programming by Packt Publishing.

Anil Mahtani

Anil Mahtani is a computer scientist who has been working for the past 5 years on underwater robotics. He first started working in the field with his master's thesis, where he developed a software architecture for a low-cost ROV. During the development of his thesis, he also became the team leader and lead developer of AVORA, a team of university students that designed and developed an autonomous underwater vehicle for the Students Autonomous Underwater Challenge – Europe (SAUC-E) in 2012. That same year, he completed his thesis and his MSc in computer science at the University of Las Palmas de Gran Canaria, and shortly thereafter, he became a software engineer at SeeByte Ltd, a world leader in smart software solutions for underwater systems. During his tenure at SeeByte Ltd, Anil was key to the development of several semi-autonomous and autonomous underwater systems for the military and the oil and gas industries. In those projects, he was heavily involved in the development of autonomous systems, the design of distributed software architectures, and low-level software development and has also contributed to providing computer vision solutions for front-looking sonar imagery. At SeeByte Ltd., he has also achieved the position of project manager, managing a team of engineers developing and maintaining the internal core C++ libraries. His professional interests lie mainly in software engineering, algorithms, distributed systems, networks, and operating systems. Anil's main role in robotics is to provide efficient and robust software solutions, addressing not only the current problems at hand but also foreseeing future problems or possible enhancements. Given his experience, he is also an asset when dealing with computer vision, machine learning, and control problems. Anil is interested in DIY and electronics, and he has developed several Arduino libraries that he has contributed back to the community.

Aaron Martinez

Aaron Martinez is a computer engineer, entrepreneur, and expert in digital fabrication. He did his master's thesis in 2010 at Instituto Universitario de Ciencias y Tecnologías Cibernéticas (IUCTC) from the University of Las Palmas de Gran Canaria. He prepared his master's thesis in the field of telepresence using immersive devices and robotic platforms. After completing his academic career, he attended an internship program at The Institute for Robotics at the Johannes Kepler University in Linz, Austria. During his internship program, he worked as part of a development team of a mobile platform using ROS and the navigation stack. After that, he was involved in projects related to robotics; one of them is the AVORA project at the University of Las Palmas de Gran Canaria. In this project, he worked on the creation of an autonomous underwater vehicle (AUV) to participate in the Student Autonomous Underwater Challenge-Europe (SAUC-E) in Italy. In 2012, he was responsible for manufacturing this project; in 2013, he helped adapt the navigation stack and other algorithms from ROS to the robotic platform. Recently, Aaron cofounded a company called SubSeaMechatronics, SL. This company works on projects related to underwater robotics and telecontrol systems; it also designs and manufactures subsea sensors. The main purpose of the company is to develop custom solutions for R&D prototypes and heavy-duty robots. Aaron has experience in many fields, such as

programming, robotics, mechatronics, and digital fabrication, and devices such as Arduino, BeagleBone, servers, and LIDAR. Nowadays, he is designing robotics platforms for underwater and aerial environments at SubSeaMechatronics SL.

Users Review

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Carol Hughes:

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David Betancourt:

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