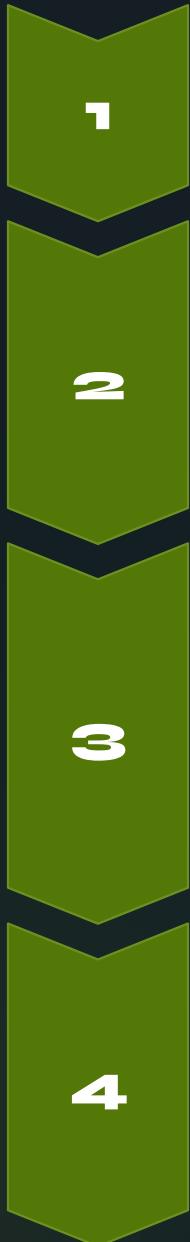


# ROS 机器人操作系统指南

ROS (机器人操作系统) 是目前最流行的机器人软件平台，为开发者提供了丰富的工具和库，支持各种类型的机器人开发。本文档将全面介绍ROS的基本概念、操作方法和应用场景。

c by Chuchu Xu

# ROS基本操作



## 运行 (Run)

- Run roscore.
- Run ROS Node.
- Running the Node.
- Now let's run the publisher.

## 创建 (Create)

- Creating a Package.
- The 'catkin\\_\\_generate\\_\\_changelog' is a command that creates the 'CHANGELOG.rst' file that logs the changes when updating the version of a package.
- Create a new bag file with the specific content removed.

## 修改 (Modify)

- Modifying the Package Configuration File (package.xml).
- Modifying the Build Configuration File (CMakeLists.txt).
- Let's modify the 'service\\_\\_server.cpp' source in the service server and the client node created in Section 7.3 to use parameters to perform arithmetic operations, rather than just adding two values entered as service request.

## 构建 (Build)

- Build System.
- Building the Package.
- Building a Node.
- If you check the package dependencies in the Wiki page of the 'find\\_\\_object\\_\\_2d' package, you can see that this package depends on a total of 12 different packages.

# ROS信息管理

## 检查 (Check)

- Check file list of ROS package.
- Check ROS topic information.
- Check ROS service information.
- Check ROS node information.
- Check and edit ROS parameter information.
- Okay to perform: `rm -rf /home/pyo/.ros/log (y/n)?`

## 查看 (View)

- View information regarding a specific ROS package.
- We can view messages such as 'hello world!0,1,2,3 ...' in the terminal window in strings.

## 覆盖 (Cover)

- We tried to make this a comprehensive guide that covers all aspects necessary for a beginner in ROS.
- Topics such as embedded system, mobile robots, and robot arms programmed with ROS are included.
- All source codes covered in this book are downloaded from the GitHub repository.

# ROS开发环境与参与

## 参与 (Participate)

◦ I hope that more people will be aware of and participate in bringing forward the ever-accelerating collective knowledge of Robotics Engineering. ◦ I would also like to thank Dr. Yoon Seok Pyo, who gave me the opportunity to participate in writing this book.

## 意识到 (Realize)

◦ I hope that more people will be aware of and participate in bringing forward the ever-accelerating collective knowledge of Robotics Engineering.

## 加速 (Accelerate)

◦ I hope that more people will be aware of and participate in bringing forward the ever-accelerating collective knowledge of Robotics Engineering.

## 克服 (Overcome)

◦ I would like to thank Hyung Joon Pyo, Hyung il Park, and Byung Hoon Park for our joined efforts in creating OpenCR. I will cherish memories of you helping me to overcome my shortcomings.

## 带领 (Lead)

◦ Many of the companies leading the industrial robot field participate in this consortium and are solving some of the newly emerging and difficult problems from the industrial robot field one by one, such as in automation, sensing, and collaborative robot.

## 满意 (Satisfy)

◦ Even when I would succeed in making simple movements, I was so pleased and content thinking "This is a robot!".

# ROS术语与概念

1

## 称之为 (Call)

- Even cars, planes, and submarines can now be called robot platforms as makers began to automate their own products.
- The most popular robot software platform is ROS, a Robot Operating System that will be called in this book.
- This is called path search and planning, and there are many algorithms that perform this such as A\\* algorithm, potential field, particle filter, and RRT (Rapidly-exploring Random Tree).

2

## 自动化 (Automate)

- Even cars, planes, and submarines can now be called robot platforms as makers began to automate their own products.

3

## 包含 (Encompass)

- As people in various fields started to incorporate technology that encompasses a wide range of knowledge, robots have finally begun taking the form of what it has long been dreamed of.

4

## 允许 (Allow)

- You have allowed me to walk the path of a researcher, and I continue to learn much from you.
- ROS, which supports robots with various purposes, allows developer to select the most appropriate language according to the purpose.



Made with Gamma

# ROS控制与设置



# ROS支持与开发

## 支持 (Support)

- For their mobile robot they used the mobile robot base from Yujin Robot which supports ROS, for the actuator they used ROBOTIS Dynamixel.
- The ROS program provides a client library to support various programming languages.
- ROS supports communication between different devices through the use of message communication, message, name, transform function, and client library (see Figure 4-18).

## 选择 (Select)

- The developer will select the most suitable language depends on the nature of the work.
- ROS, which supports robots with various purposes, allows developer to select the most appropriate language according to the purpose.



## 导入 (Import)

- The library can be imported in programming languages that are popular in the robotics field such as Python, C++, and Lisp as well as languages such as JAVA, C#, Lua, and Ruby.

## 开发 (Develop)

- Professional researchers and engineers who work on robot development or software programming.
- I am researching and developing an intelligent system for open source based service robot platform.
- Many camera-related packages require this package.

# ROS通信和数据处理

## 通信机制

- 行动 (Act): ◦ A master acts like a name server as it keeps names of nodes, topics, services and action as well as the URI address, port number and parameters.
- 发送 (Send): ◦ The publisher node registers its own information and topic with the master, and sends a message to connected subscriber nodes that are interested in the same topic. ◦ As topics are unidirectional and remain connected to continuously send or receive messages, it is suitable for sensor data that requires publishing messages periodically.
- 传输 (Transmit): ◦ Communication on topic uses the same type of message for both publisher and subscriber as shown in Figure 4-2. The subscriber node receives the information of publisher node corresponding to the identical topic name registered in the master. Based on this information, the subscriber node directly connects to the publisher node to receive messages.
- 接收 (Receive): ◦ The subscriber node registers its own information and topic with the master, and receives publisher information that publishes relative topic from the master.

## 数据处理

- 产生 (Generate): ◦ If the current position of the robot is generated in the form of odometry information by calculating the encoder values of both wheels of the mobile robot, the asynchronous odometry information can be continuously transmitted in unidirectional flow using a topic message(x, y, i).
- 计算 (Calculate): ◦ If the current position of the robot is generated in the form of odometry information by calculating the encoder values of both wheels of the mobile robot, the asynchronous odometry information can be continuously transmitted in unidirectional flow using a topic message(x, y, i).
- 测量 (Measure): ◦ You can also see that the distance measured data for each angle is being published as an array 'ranges'. ◦ The OpenCR can measure the voltage input from the battery or SMPS.
- 检测 (Detect): ◦ As another example of using LDS, the robot is able to detect various objects in the surroundings and react based on the current environment as shown in Fig. 8-19.

## 连接与请求

- 连接 (Connect): Based on received publisher information, the subscriber node directly requests connection to the publisher node and receives messages from the connected publisher node.
- 请求 (Request): Service communication on service is a bidirectional synchronous communication between the service client requesting a service and the service server responding to the request as shown in Figure 4-3.
- 响应 (Respond): Service communication on service is a bidirectional synchronous communication between the service client requesting a service and the service server responding to the request as shown in Figure 4-3.

## 其他功能

- 保存 (Save): The previously created occupancy grid map is saved at the '/maps' folder.
- 应用 (Apply): ROS application development environment. ◦ In the kinetic version page, you can check the list of dependent packages by clicking on the 'Dependencies' link on the article menu, the link to the project's external website, the repository address of the package, and instructions about how to use the package.
- 实施 (Implement): For instance, when implementing a function that helps a robot to recognize its surrounding situation, the diversity of hardware and the fact that it is directly applied in real-life can be a burden.
- 获得 (Obtain): These sensors can be connected to ROS via UART of microprocessor or mini PCs.

## 依赖与需求

- 需要 (Require): As topics are unidirectional and remain connected to continuously send or receive messages, it is suitable for sensor data that requires publishing messages periodically. ◦ Many camera-related packages require this package.
- 依赖 (Depend): ROS provides development environments for various languages by using client library in order to reduce the dependency on the language used.
- 简化 (Simplify): However, we have included the message file in the executable node in this book to simplify the code.
- 消除 (Eliminate): If the message is created as an independent package, the message package can be added to the dependency option, thus eliminating unnecessary dependencies between packages.

## 高级功能

- 建议 (Suggest): REP is a proposal that is used when suggesting rules, new functions, and management methods within the ROS community.
- 验证 (Verify): The 'rospack list' or 'rospack find' command to verify that the necessary packages are installed.
- 启动 (Launch): Nodes register their own information with the master upon launch, and acquire relative information of other nodes from the master.
- 估计 (Estimate): SLAM (Simultaneous Localization And Mapping) means to explore and map the unknown environment while estimating the pose of the robot itself by using the mounted sensors on the robot.