Robotics and ROS

Session 01

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Who I am..

- A Computer Science and Engineering graduate
- From Batch 15 and graduated in January 2020
- Research Assistant at Intellisense Lab
- Pursuing a master’s degree with major component in Research

What I studied ..

- Semester 5 : Started learning about Robotics during
- Semester 6 : Learnt about MATLAB modeling and Solidworks
- Semester 7 : Learnt about Robot navigation, Control and ROS
- Semester 8 : Module on Robotics
- Research Assist. : Px4 and MAVROS
- Masters Research : Multi robot systems

What I did and currently working on..

- Exploration system for an unknown environment
- Multi-robots for unknown environment exploration

Session Plan

Session 01

Robotics and ROS

- Introduction to basic concepts of Robotics
- Introduction to ROS
- When and How to use ROS in robotics

Session 02

Communication infrastructure in ROS

- Publisher Subscriber
- Client Server
- Actions

Session Plan (cont..)

Session 03

Robot specific infrastructure of ROS

- Standard Message Definitions
- Introduction to Robot Geometry library
- Introduction to Robot Description language

Session 04

Development tools available in ROS

- rosrun, roslaunch
- rostopic, rosservice
- rqt_graph
- rqt_tf_tree

planned based on slides titled 240AR060 Master's degree in Automatic Control and Robotics – Introduction to ROS by Jan Rosell / Carlos Rosales

Robotics and ROS

Introduction to basic concepts of robotics

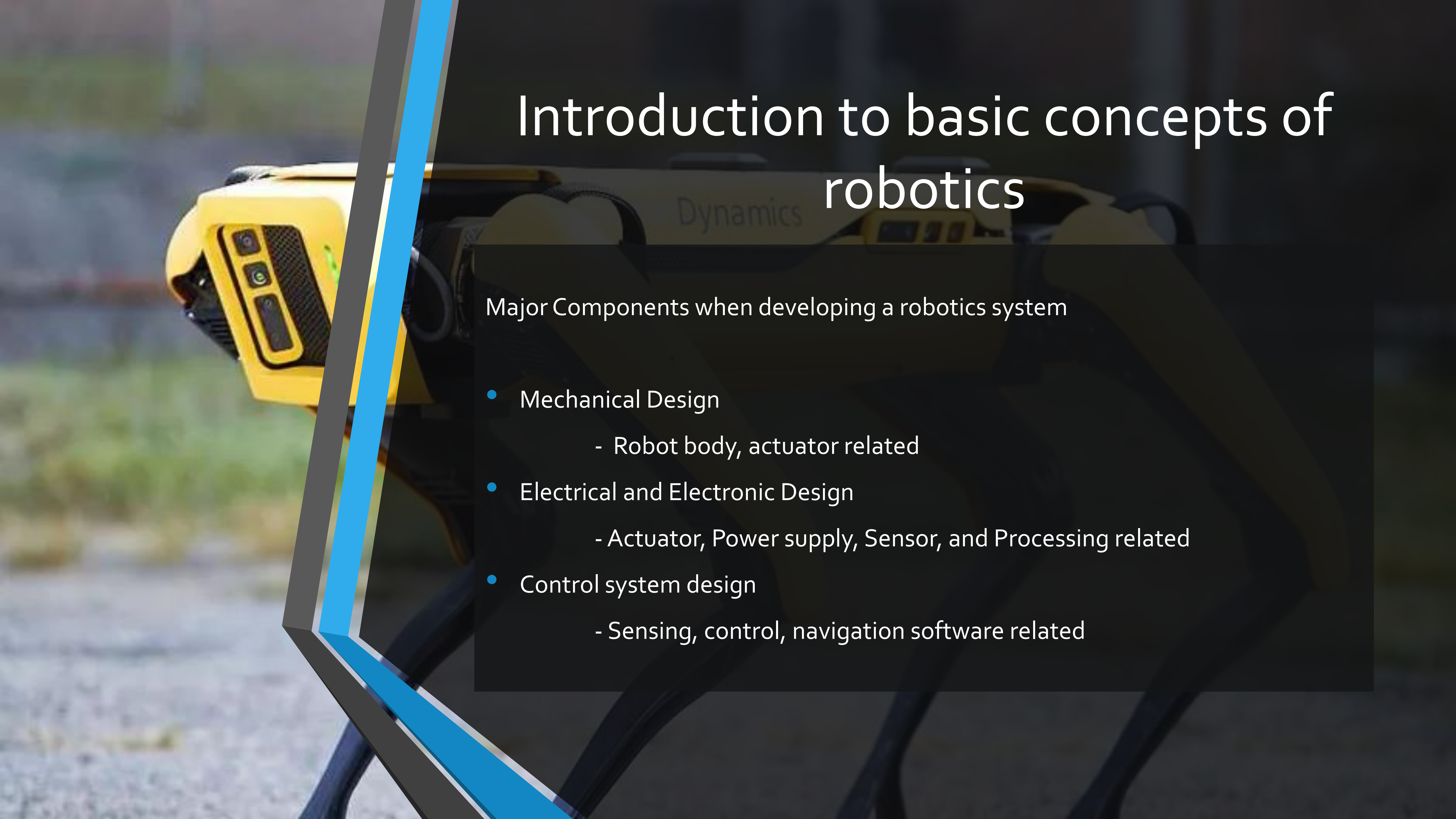
Introduction to basic concepts of robotics

What is Robotics?

Robotics is an interdisciplinary research area at the interface of computer science and engineering. Robotics involves design, construction, operation, and use of robots. The goal of robotics is to design intelligent machines that can help and assist humans in their day-to-day lives and keep everyone safe.

Wikipedia

Introduction to basic concepts of robotics



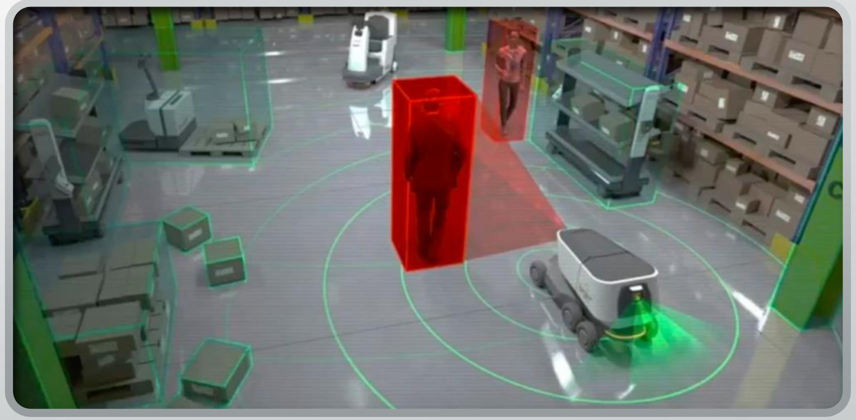
Major Components when developing a robotics system

- Mechanical Design
  - Robot body, actuator related
- Electrical and Electronic Design
  - Actuator, Power supply, Sensor, and Processing related
- Control system design
  - Sensing, control, navigation software related

Introduction to basic concepts of robotics

Control system design

- Perception
  - Lidar/Kinect/RGBD camera
  - Wheel encoders/IMU/GPS
- Control
  - Balancing and movement
  - Velocity and acceleration calculation
- Navigation
  - Path planning
  - localization



Robotics and ROS

Introduction to Robot Operating System

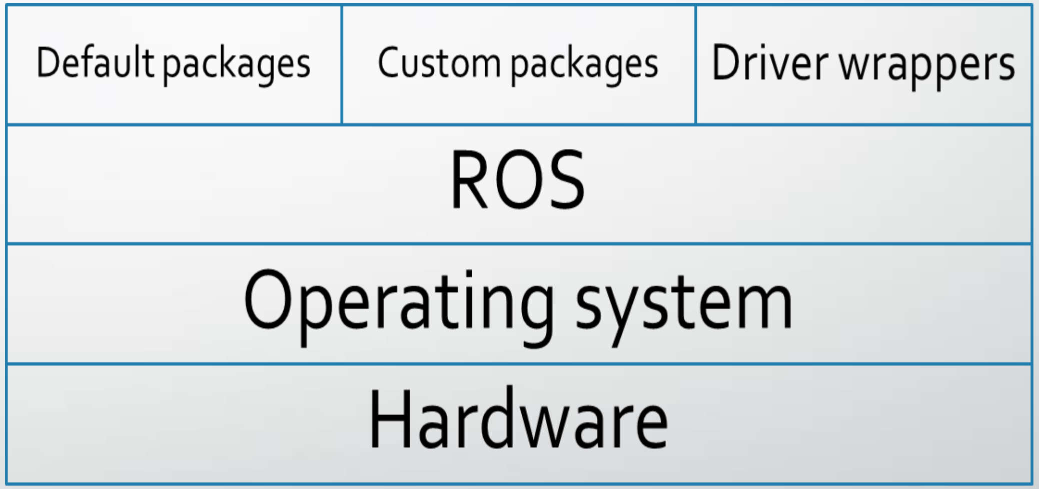
Introduction to ROS

What is ROS?

ROS is an open-source, meta-operating system for your robot. It provides the services you would expect from an operating system, including **hardware abstraction**, **low-level device control**, **implementation of commonly-used functionality**, **message-passing between processes**, and **package management**. It also provides tools and libraries for obtaining, building, writing, and running code across multiple computers.

wiki.ros.org

Introduction to ROS



Default packages

Custom packages

Driver wrappers

ROS

Operating system

Hardware

For Hands on sessions we will be using Ubuntu 18.04 based ROS Melodic

Introduction to ROS

A distributed system	enables carrying out of several tasks at once spanning across several processes and even several computers
Language independent	Python, C++, Lisp, Java, Lua
Allows code reuse	Package based application development
Rapid Testing	Availability of simulators and test tools to test and debug the code before deployment
Scalability	ROS is appropriate for large runtime systems and for large development processes.

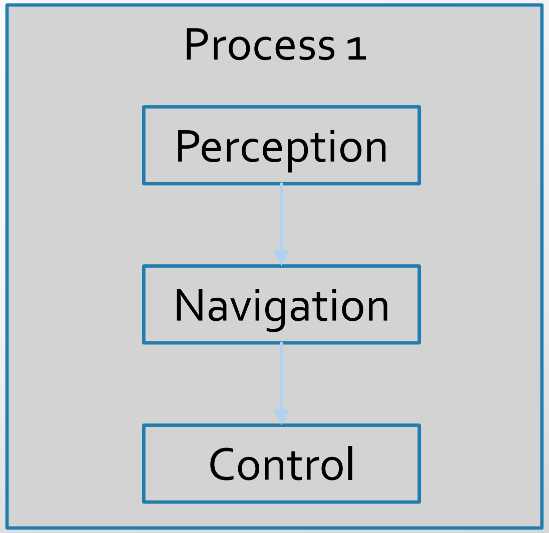
Robotics and ROS

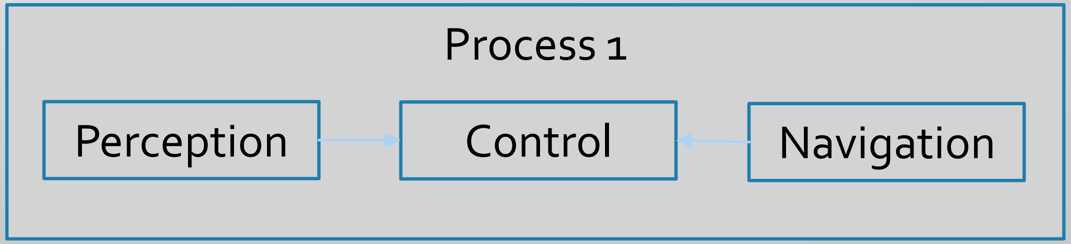
When and How to use ROS in robotics

When and How to use ROS in robotics

Control system design without ROS

- Perception
  - Lidar/Kinect/RGBD camera
  - Wheel encoders/IMU/GPS
- Control
  - Balancing and movement
  - Velocity and acceleration calculation
- Navigation
  - Path planning
  - localization





When and How to use ROS in robotics

Control system design with ROS

- Perception
  - Lidar/Kinect/RGBD camera
  - Wheel encoders/IMU/GPS
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  - Balancing and movement
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  - Path planning
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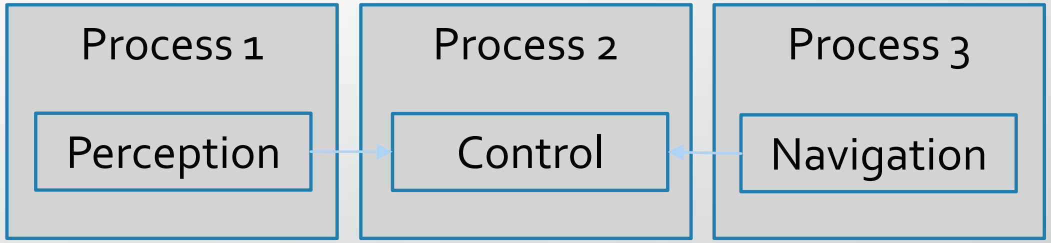
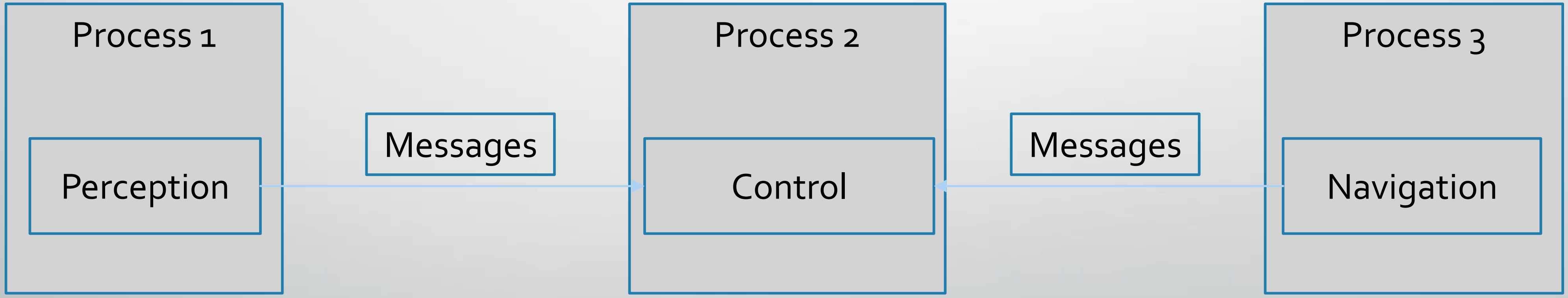


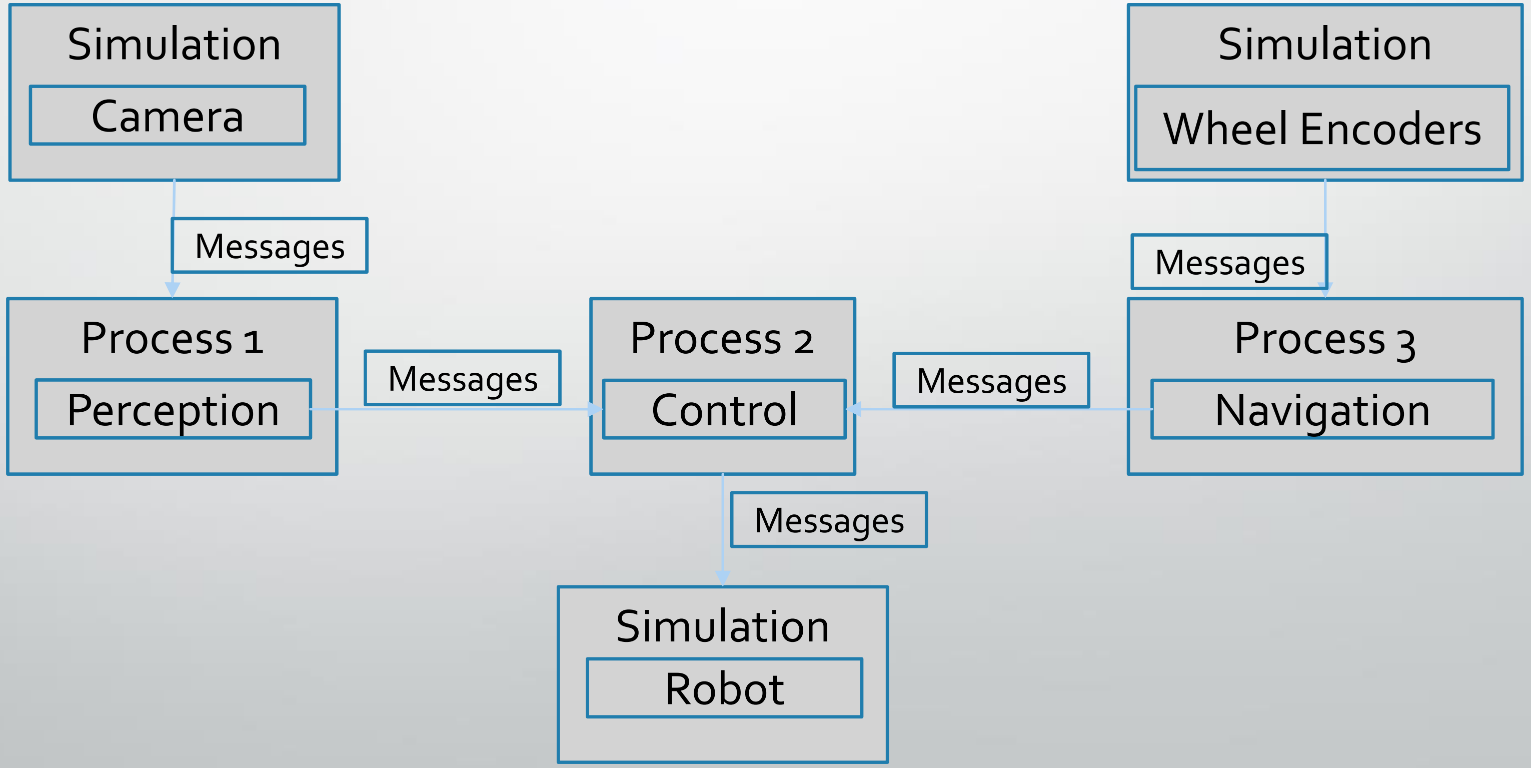
When and How to use ROS in robotics

Control system design with ROS



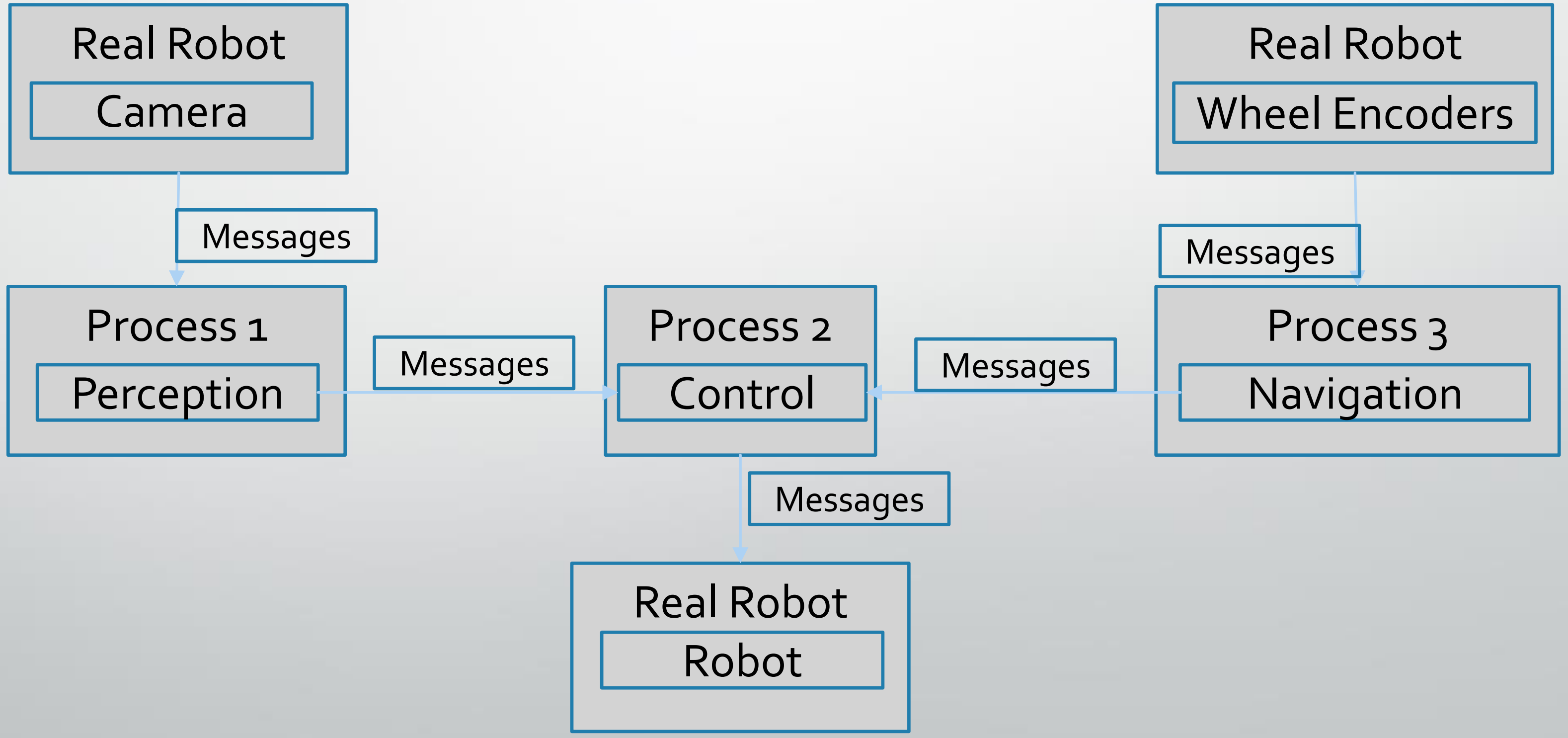
When and How to use ROS in robotics

Testing



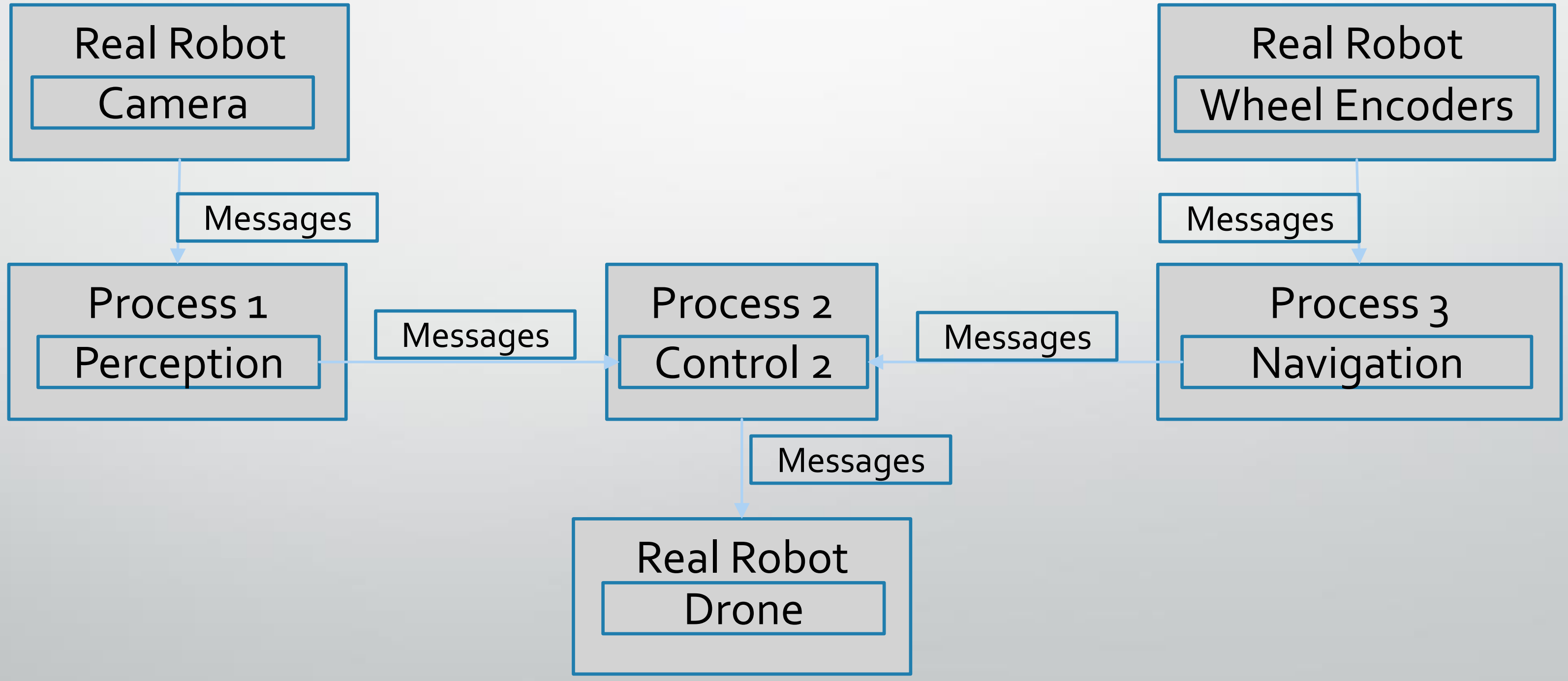
When and How to use ROS in robotics

Deployment



When and How to use ROS in robotics

Code Reuse



Real Robot

Camera

Messages

Real Robot

Wheel Encoders

Messages

Process 1

Perception

Messages

Process 2

Control 2

Messages

Process 3

Navigation

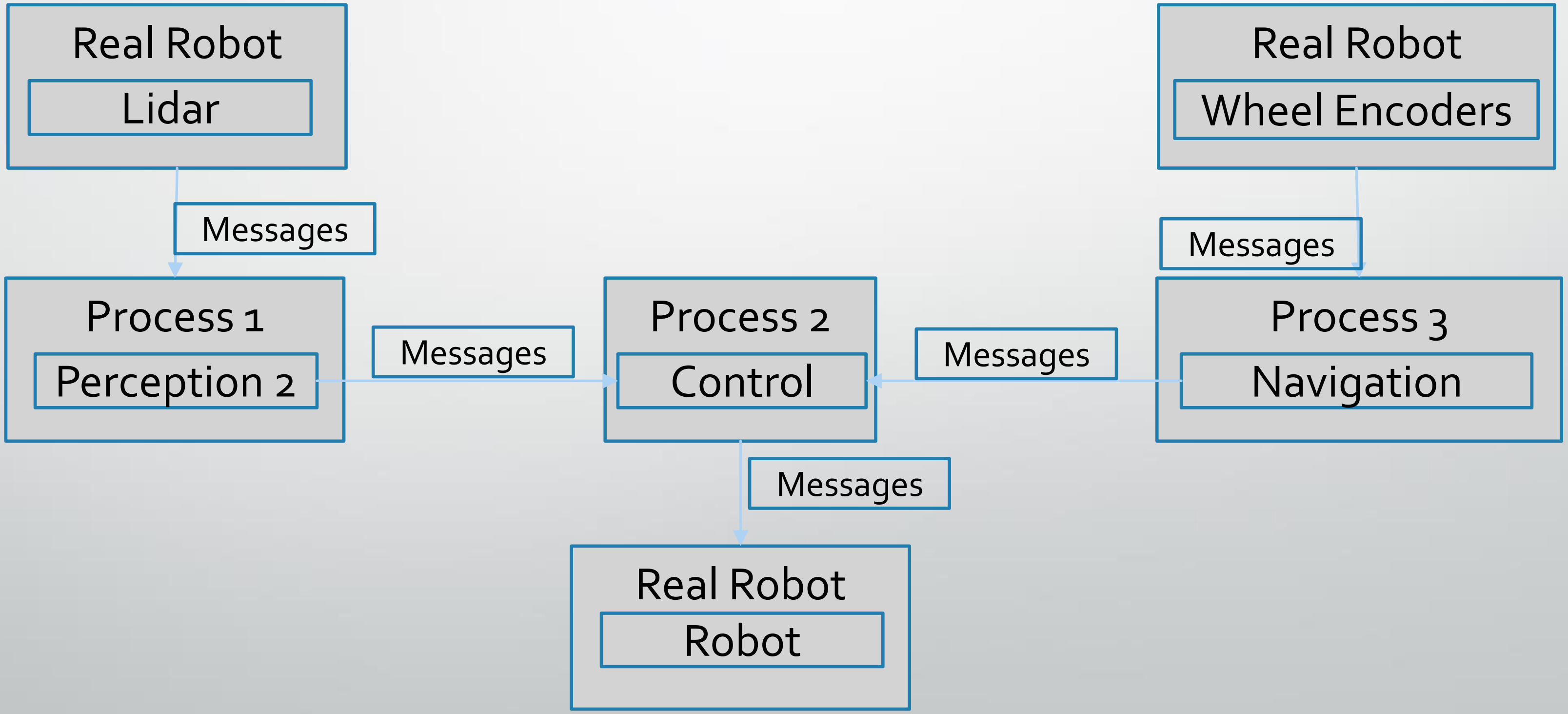
Messages

Real Robot

Drone

When and How to use ROS in robotics

Code Reuse another example



Real Robot

Lidar

Messages

Process 1

Perception 2

Messages

Process 2

Control

Messages

Real Robot

Wheel Encoders

Messages

Process 3

Navigation

Messages

Real Robot

Robot

Q&A

Thank you