ROS-I Training Class

BASIC DEVELOPERS' TRAINING CLASS

February 13 – 15, 2017

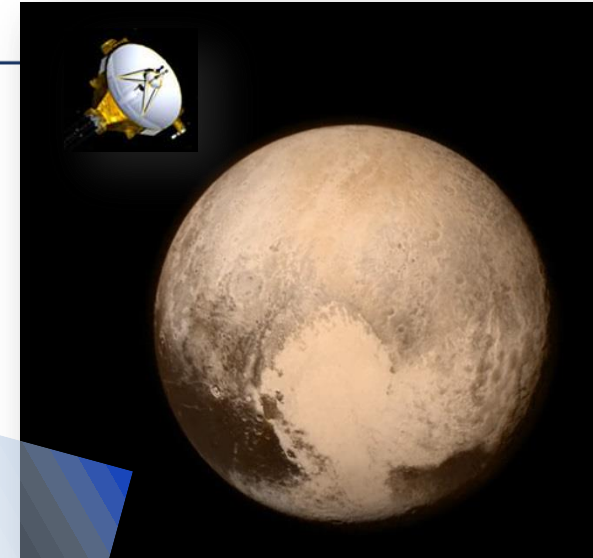Presented by Southwest Research Institute

INTRODUCTIONS:
SWRI

SwRI: Deep Sea to Deep Space

**Independent.
Advanced Science.
Applied Technology.
From *Deep Sea*
To *Deep Space*.
And Everything in between.**

- **New Horizons**
  - SwRI-lead
  - Launched: Jan. 19, 2006
  - Closest approach to Pluto: July 14, 2015
  - Fastest spacecraft ever: ~30,000 mph

- **Alvin**
  - Tested at SwRI before first (1964) record-setting dives > 8,000 ft.
  - Redesigned (2013) new Alvin (3" titanium sphere) capable of > 21,000 ft.
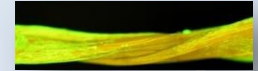
SwRI: Deep Sea to Deep Space

And Everything Between!

Spacecraft & Planetary Sciences
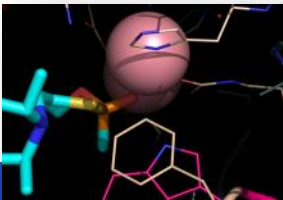
Energy

Robotics, Automation, and Simulations
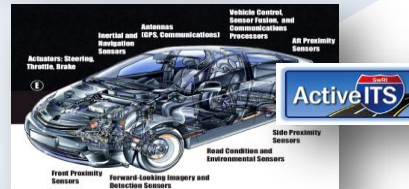
Regenerative Medicine

Lubricants Testing

Materials & Engineering

Pharmaceuticals & Bioengineering

Infrastructure Communications

Engine Design and Optimization

Water and Geological Engineering

INTRODUCTIONS: INSTRUCTORS

Instructors

Jeremy Zoss

Levi Armstrong

INTRODUCTIONS:
OTHER SWRI PERSONNEL

Contact Info

Paul Hvass

Program Manager

ROS-I Consortium Americas

SwRI
9503 W. Commerce
San Antonio, TX 78227
USA

Phone: 210-522-5823
Email: paul.hvass@swri.org

www.ROS-Industrial.org

Daily Schedule, Wiki & Github (Slides, Exercises)

CLASS LOGISTICS:
AGENDA AND NAVIGATION

Monday Agenda

- 0815 Shuttle Departs the [Hyatt Hill Country](#)
- 0835 Sign-in, Introductions, and Agenda
- 0900 ROS Setup, Catkin, Installing Packages
- 1015 Break
- 1030 Creating Packages/Nodes, Topics, Messages
- 1200 Lunch – SwRI Overview Presentation
- 1300 Services, Actions
- 1430 Break
- 1445 Launch Files, Parameters
- 1720 Shuttle Departs for Dinner
- 1800 Group Dinner at [Acenar](#) on the Riverwalk

Tuesday Agenda

- 0815 Shuttle Departs the [Hyatt Hill Country](#)
- 0835 Recap and Agenda
- 0900 URDF, Workcell XACRO
- 1015 Break
- 1030 TF, Build a MoveIt! Package
- 1200 Lunch – SwRI Lab Tours
- 1330 Motion Planning Using Rviz, C++
- 1500 Break
- 1515 Descartes Path Planning, Intro to Perception
- 1720 Shuttle Departs for Dinner
- 1800 Group Dinner at [Two Bros. BBQ](#)

Wednesday Lab Agenda

- 0815 Shuttle Departs the [Hyatt Hill Country](#)
- 0835 Recap and Agenda
- 0900 Building a Perception Pipeline, Recap
- 1030 Break
- 1045 Lab Introduction, Lab Time
    1. Pick and Place Application
    2. Descartes Application
- 1200 Lunch
- 1245 Work on Lab Applications
- 1530 Wrap-up, Surveys
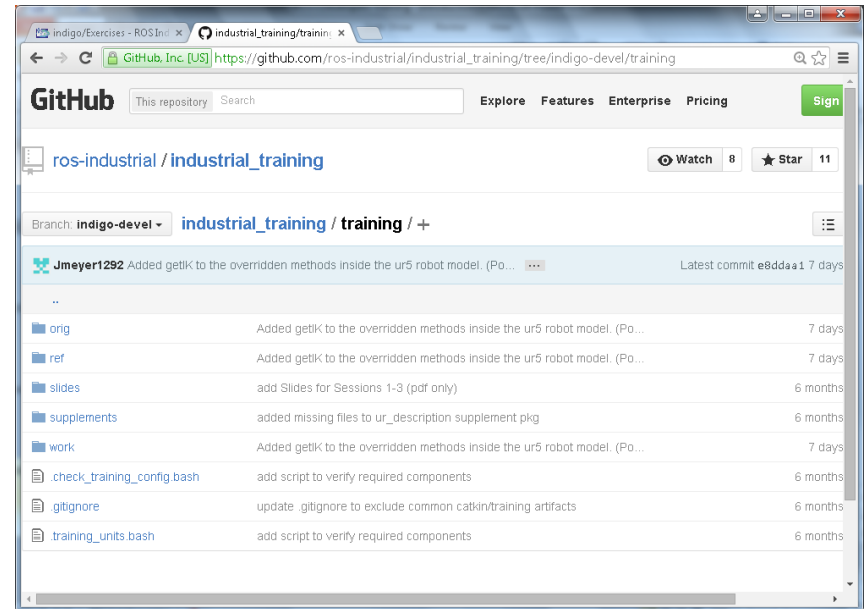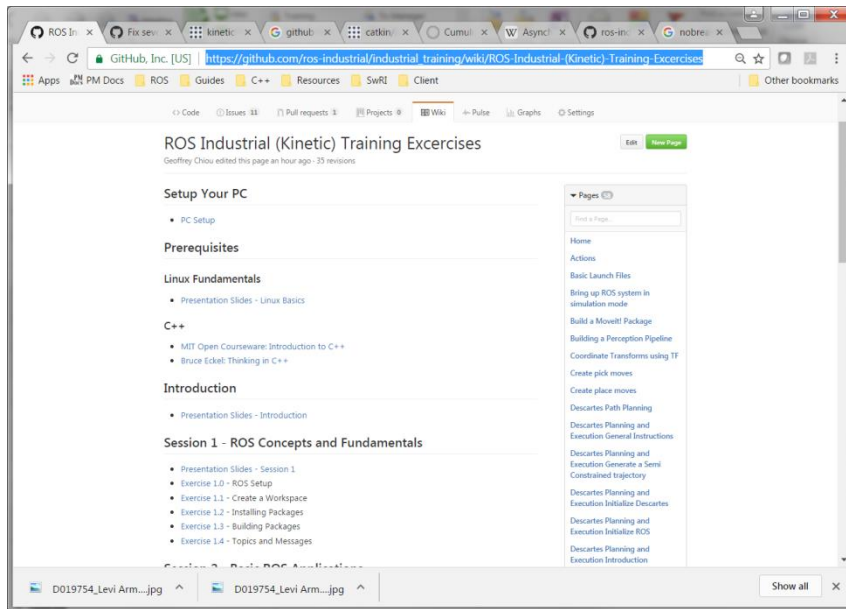- 1600 Shuttles Depart for Airport and Hyatt
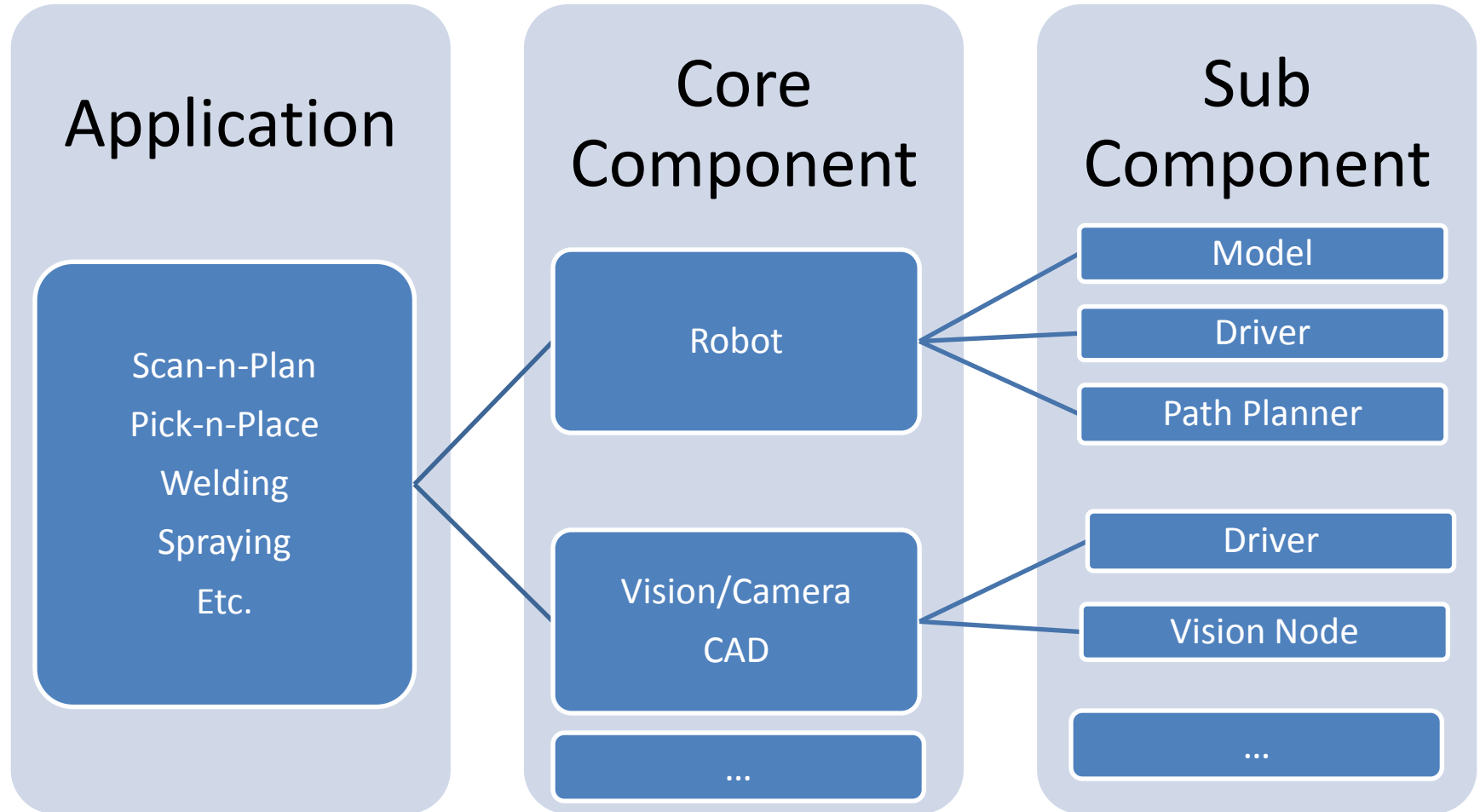- End

Wiki & Github

https://github.com/ros-industrial/industrial_training/wiki

https://github.com/ros-industrial/industrial_training

Generic App. Architecture

Application

Scan-n-Plan

Pick-n-Place

Welding

Spraying

Etc.

Core Component

Robot

Vision/Camera

CAD

...

Sub Component

Model

Driver

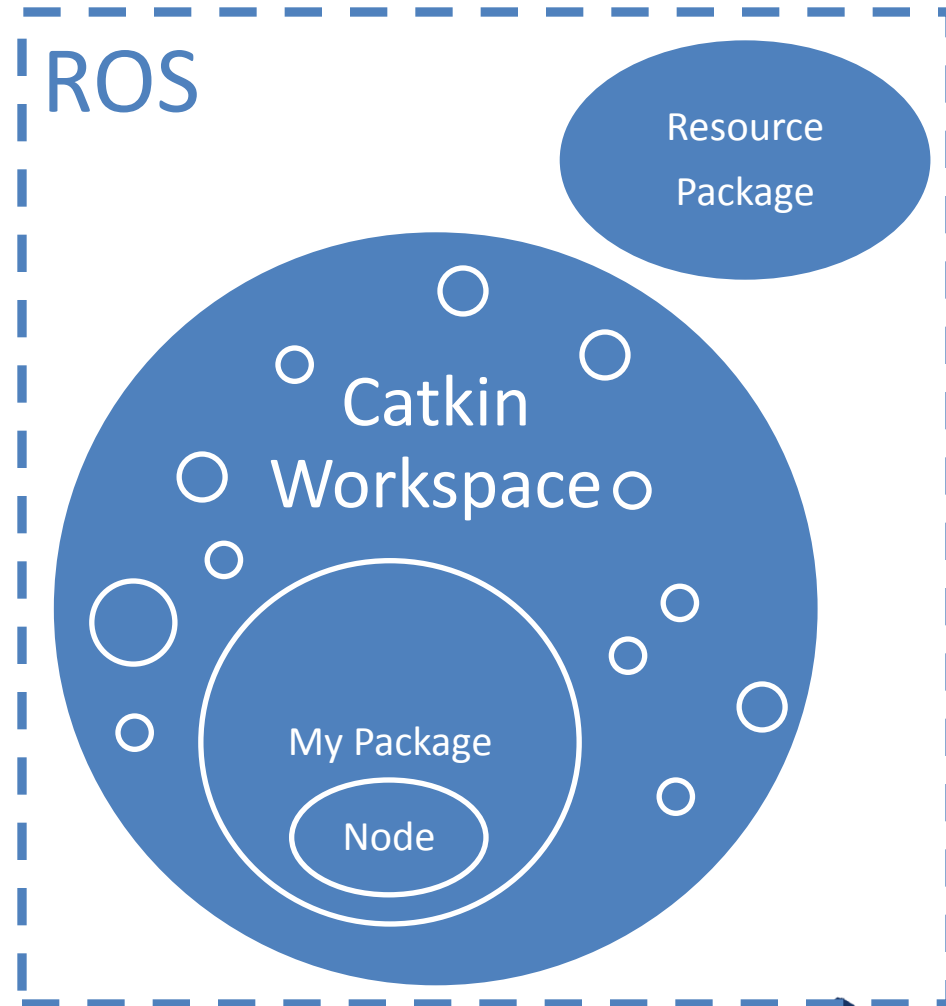Path Planner

Driver

Vision Node

...

Day 1 Progression

- ☐ Install ROS
- ☐ Create Workspace
- ☐ Add "resources"
- ☐ Create Package
- ☐ Create Node
  - ☐ Basic ROS Node
  - ☐ Interact with other nodes
    - ☐ Messages
    - ☐ Services
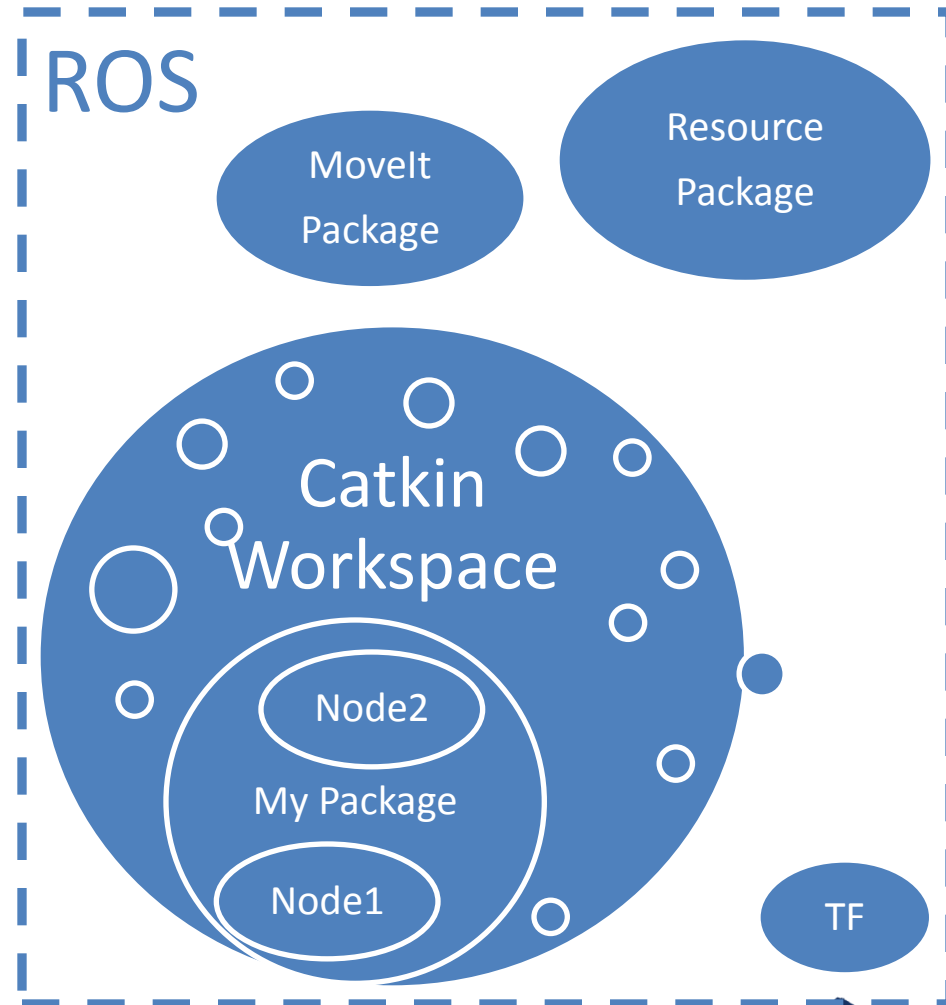- ☐ Run Node
  - ☐ rosrun
  - ☐ roslaunch

ROS

Resource Package

Catkin Workspace

My Package

Node

Day 2 Progression

- ❑ Build on Day 1 nodes
- ❑ Use TF
- ❑ Create Robot Model
  - ❑ Basic, URDF
  - ❑ Advanced, xacro
- ❑ Integrate Robot Model
  - ❑ MoveIt
- ❑ Integrate Path Planner
  - ❑ Descartes
- ❑ Dabble in Perception

ROS

MoveIt Package

Resource Package

Catkin Workspace

Node2

My Package

Node1

TF

Day 3 Overview

❑ Review Day 1/2 Topics

❑ Self-Paced Application Demos

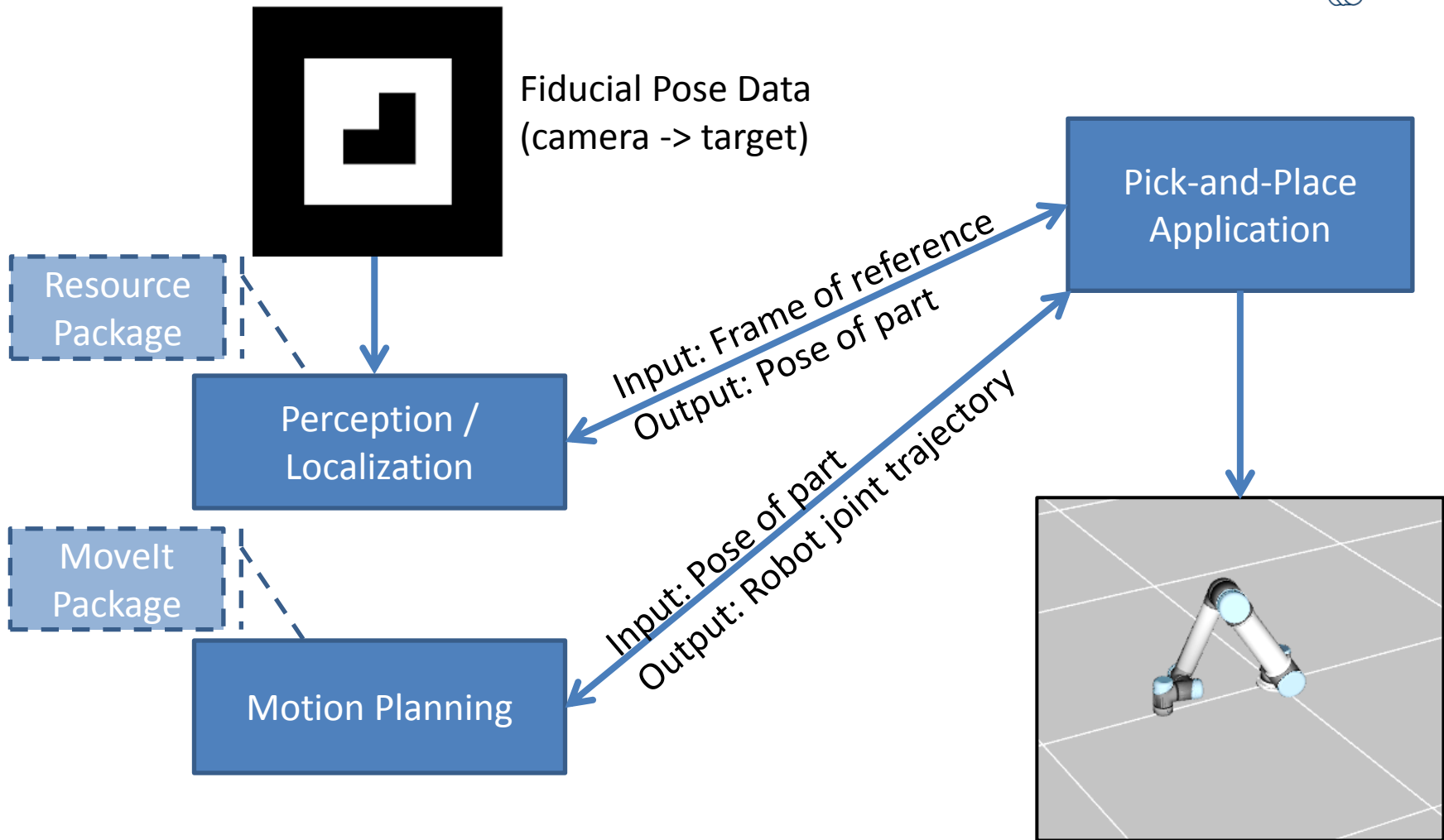1. Perception-Driven Manipulation

   (a.k.a. Vision-Guided Pick & Place)

2. Descartes Planning & Execution

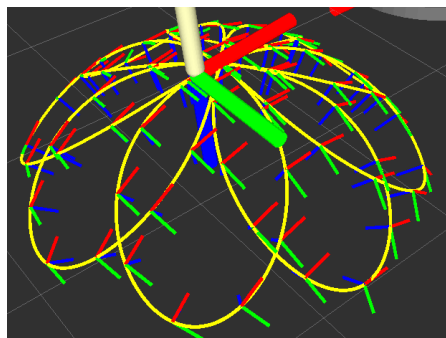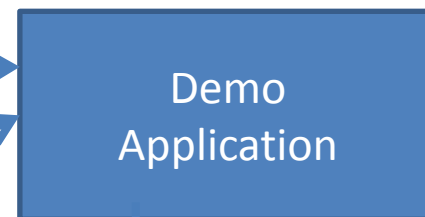   *(a.k.a. Semi-Constrained Path-Planning)*

Demo #1: Pick-and-Place

Fiducial Pose Data
(camera -> target)

Resource
Package

Perception /
Localization

MoveIt
Package

Motion Planning

Pick-and-Place
Application

Input: Frame of reference
Output: Pose of part

Input: Pose of part
Output: Robot joint trajectory

Demo #2: Descartes

Semi-Constrained
Path Points

Demo
Application

Input: Path Constraints
Output: Robot Joint Trajectory

Descartes Planner
Graph-Based Search

Motion Execution