



ROS

New Horizons for
European Open Source
Robotics

industrial



6th ROS-Industrial
Conference 2018



Fraunhofer

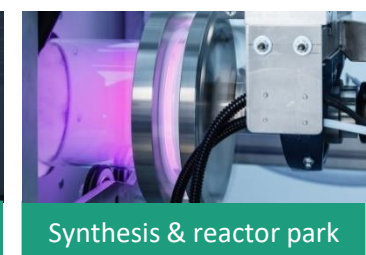
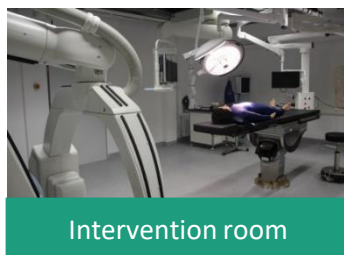
IPA

Fraunhofer IPA

The organisation



- ❑ Fraunhofer Gesellschaft: the largest applied research organization in Europe
- ❑ Non-profit, network of 80+ institutes, 28k+ employees, €2.8B annual budget
- ❑ Fraunhofer IPA: focus on Manufacturing Engineering and Automation, €70M+ annual budget, located in Stuttgart – Germany, the “silicon valley of mechatronics”

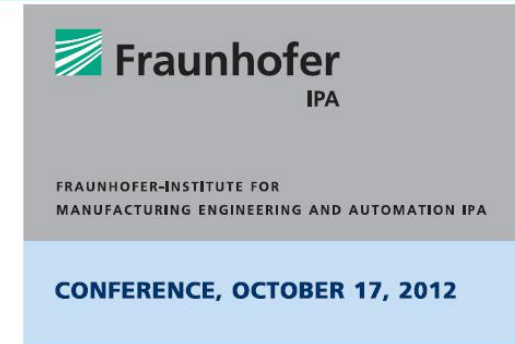


Fraunhofer IPA

Adapting ROS internally

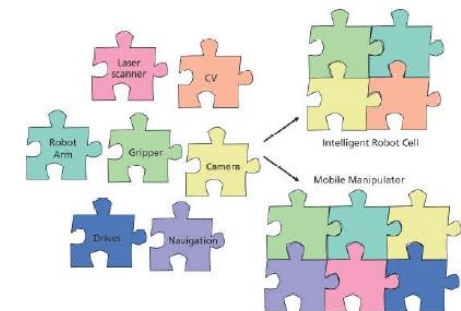


- Early ROS adopters in Europe (since the late 2000s)
- Developers of service robotics platforms (Care-O-bot)
- Piloting with SwRI the ROS-Industrial concept (2012)
- Managing RIC-EU starting in 2014



ROS INDUSTRIAL – AN ENABLER FOR INDUSTRIAL ROBOTICS?

DEVELOPMENT OF INDUSTRIAL APPLICATIONS WITH ROS – EXPERIENCES



Care-O-bot 1 (1998)



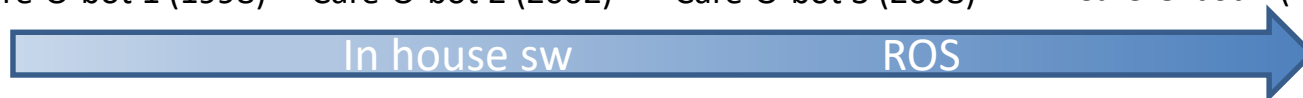
Care-O-bot 2 (2002)



Care-O-bot 3 (2008)



Care-O-bot 4 (2015)



Fraunhofer IPA

Bringing ROS into the Industry



2017

2019

2021



ROS-Industrial

Recent achievements and new horizons



Recent Achievements



New Horizons



ROSIN

Making ROS better, business friendlier and more accessible



better

Software Quality

ROS-I best practices and tools: continuous integration, unit testing, code reviews

ROSIN further improves on them with code scanning, automated test generation, model-in-the-loop testing

rosin-project.eu/software-quality-assurance

business friendlier

New components

ROSIN FTPs: 3.5 Million € to third parties for ROS-Industrial development. Develop missing components or improve existing ones.

Commercial release template (licensing, etc)

rosin-project.eu/ftps

more accessible

Education

ROSIN summer schools: Educate students

ROS-I academy: Educate professionals

Education projects: Fund your ROS education initiative

rosin-project.eu/education



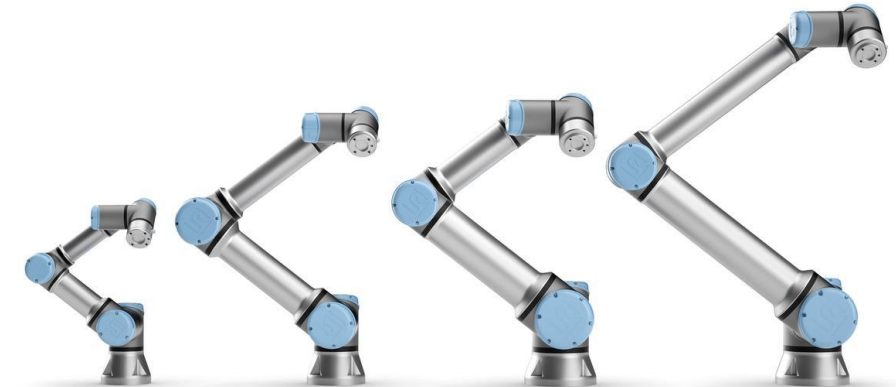
ROSIN FTP highlights

Universal robots



- ❑ Cooperation between UR & FZI
 - ❑ Driver with official OEM support
 - ❑ Integration of ROS into UR Caps
 - ❑ External control
 - ❑ Many more

KPI (github)	Value
Contributors	23
Forks	173
Stars	291



- ❑ Follow-up activities:
https://github.com/PickNikRobotics/Universal_Robots_ROS2_Driver



ROSIN FTP highlights

Pilz GmbH & Co. KG



- ❑ Project executed by Pilz GmbH & Co. KG
 - ❑ Generating LIN, PTP and CIRC trajectories
 - ❑ Industrial accuracy and performance

KPI (github)	Value
Contributors	12
Forks	26
Stars	81

- ❑ **Follow-up activities:**
https://github.com/ros-planning/moveit/tree/master/moveit_planners/pilz_industrial_motion_planner

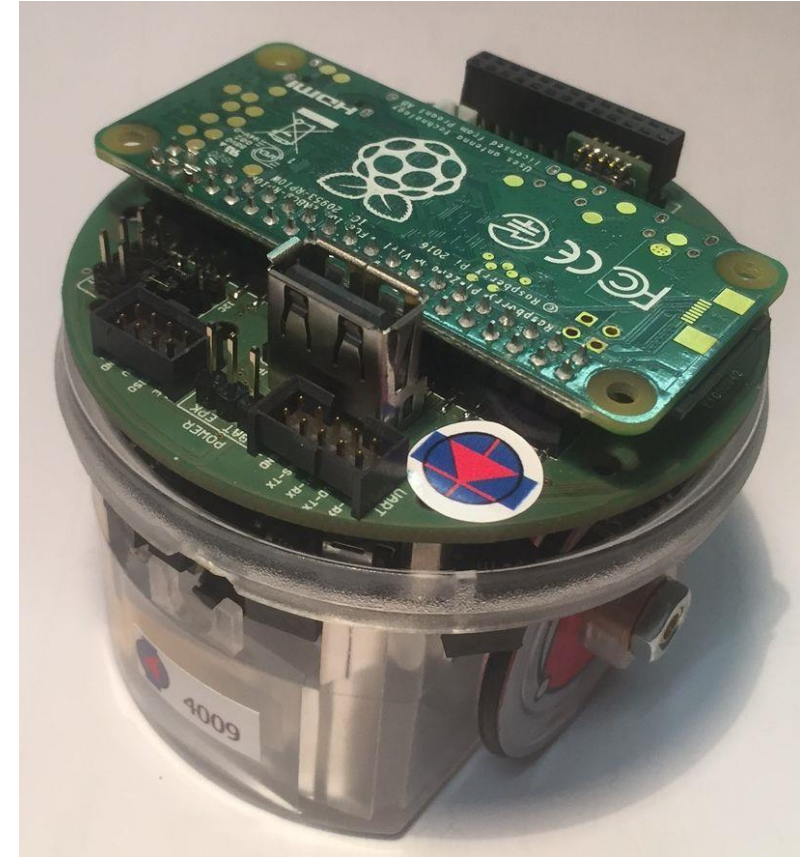


ROSIN FTP highlights

Cyberbotics



- ❑ Project executed by Cyberbotics
 - ❑ Porting of the epuck robot to ROS 2
 - ❑ Real and simulated e-puck interfaces in webots
 - ❑ ROS2 support for the webots interface



KPI (github)	Value
Contributors	3
Forks	9
Stars	17

- ❑ One of the first robots supporting ROS2
- ❑ Webots is now part of ROS core packages (<https://www.ros.org/repos/rep-2005.html>)



ROSIN FTP results



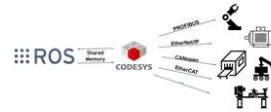
MotionBuilder

Champion PAL Robotics S.L., Spain



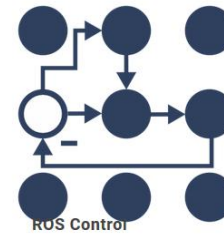
ros_control for ROS2

Champion PAL Robotics S.L., Spain



ROBIN

Champion INESC TEC, Portugal
<https://github.com/ScalABLE40/robin>



ROS Control

Champion PAL Robotics S.L., Spain
https://github.com/pal-robotics-forks/ros_control2



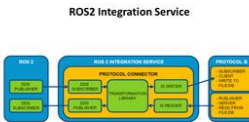
roScan

Champion Bosch Engineering GmbH, Germany



Prognostics and Health Management Tool for ROS

Champion Inovasyon Muhendislik Ltd. Sti., Turkey
https://github.com/inomuh/phm_tools



ROS2 Integration Service
Focused Technical Project (FTP) of EU H2020 project *732287
<https://github.com/eProsima/ROS2-Integration-Service>

ROS2 Integration Service

Champion eProsima - Proyectos y Sistemas de Mantenimiento SL, Spain

<https://github.com/eProsima/ROS2-Integration-Service>



ROsBOBO

Champion MANUFACTURA DE INGENIOS TECNOLOGICOS SL, Spain

<https://github.com/mintforpeople/robobo-gazebo-simulator>



RedROS2-I

Champion ALIAS ROBOTICS, Spain
https://github.com/aliasrobotics/ros2_fuzzer



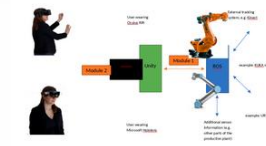
RedROS-I

Champion ALIAS ROBOTICS, Spain
<https://github.com/aliasrobotics/aztarna>



ROS Industrial Indoor Positioning System

Champion Inovasyon Muhendislik Ltd Sti., Turkey
https://github.com/inomuh/indoor_localization



Rvis2AR – Visualization platform for AR / VR devices

Champion Awesome Technologies Innovationslabor GmbH, Germany
<https://github.com/Awesome-Technologies/Rviz2AR>

Checkout <https://www.rosin-project.eu/results>



ROS-Industrial

Recent achievements and new horizons



Recent Achievements



New Horizons



Cognitive Robotics & AI Innovation Center

ROS-I lighthouse in Baden-Württemberg - Germany



- ❑ Pre-funding of 2 M€ acquired in 2019 from regional government
 - ❑ Until now 41 transfer projects with companies from BW executed by center (Sick, Pilz, Siemens, ...)
- ❑ Follow-up funding of 23 M€ acquired in 2021 for coming four years
 - ❑ Approximately 10 M€ are invested in new and improved ROS based technologies
 - ❑ 30% of the developments are foreseen for open source release



ROS-Industrial Research Activities

Hybrid model-driven engineering for ROS



Problem	ROS-Industrial Solution
No integrated development solution available	Graphical ROS development toolchain
ROS-based robot systems are complex to understand	Graphical modeling of ROS-systems and -components
Ecosystem packages not modeled	Model-extraction using static and dynamic analysis approaches
MBSE is not common in the ROS community	Generation of boilerplate code for hand-written nodes
Testing by trial-and-error method	Validation of the composition and autogeneration of deployment artifacts

Contact:

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Technology readiness:

ROS1: Tested
ROS2: Under development

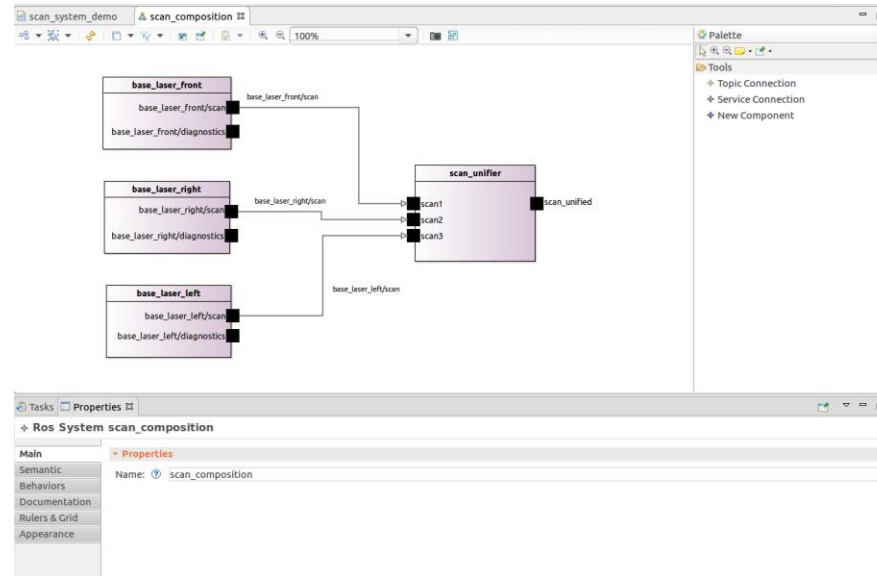
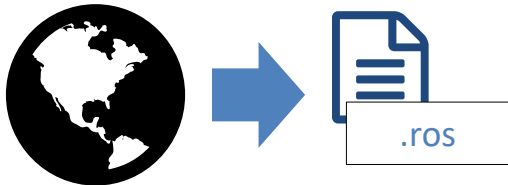
Sources:

<https://github.com/ipa320/ros-model>



ROS-Industrial Research Activities

Hybrid model-driven engineering for ROS



Launchfiles



Python
boilerplate code



C++
boilerplate code



ROS workspace
structure

Step 1:
Model-extraction

Step 2:
Graphical ROS system design

Step 3:
Generating ROS files



ROS-Industrial Research Activities

Model-based observer generation



Goal:

- Model-based diagnosis and monitoring framework for running ROS systems

Features:

- ROS Graph Observer:**
Continuous evaluation of ROS components and interfaces
- Property Observer:**
Design-time application-independent generation of property observers (ranges or complex functions)
- Integration** with common ROS diagnostics tools

Contact:

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hsd@ipa.fraunhofer.de

Technology readiness:

ROS1: Tested – Documentation in progress
ROS2: Under development

Sources:

https://github.com/rosin-project/rosgraph_monitor

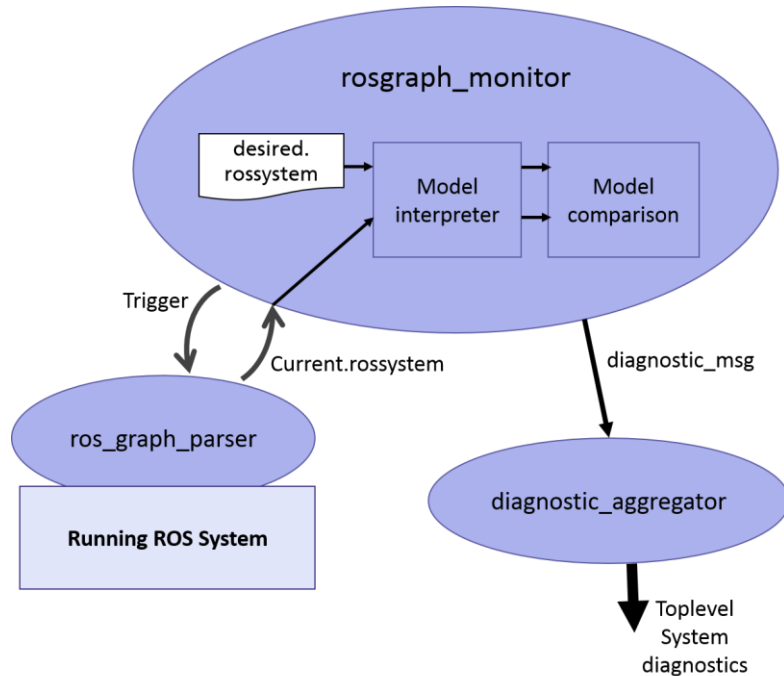


ROS-Industrial Research Activities

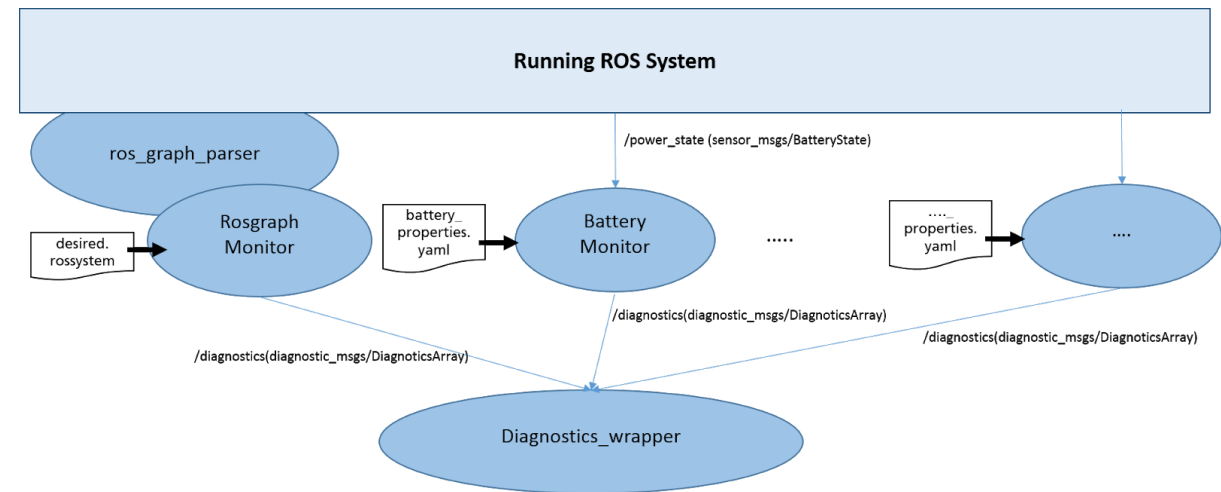
Model-based observer generation



ROS Graph Observer

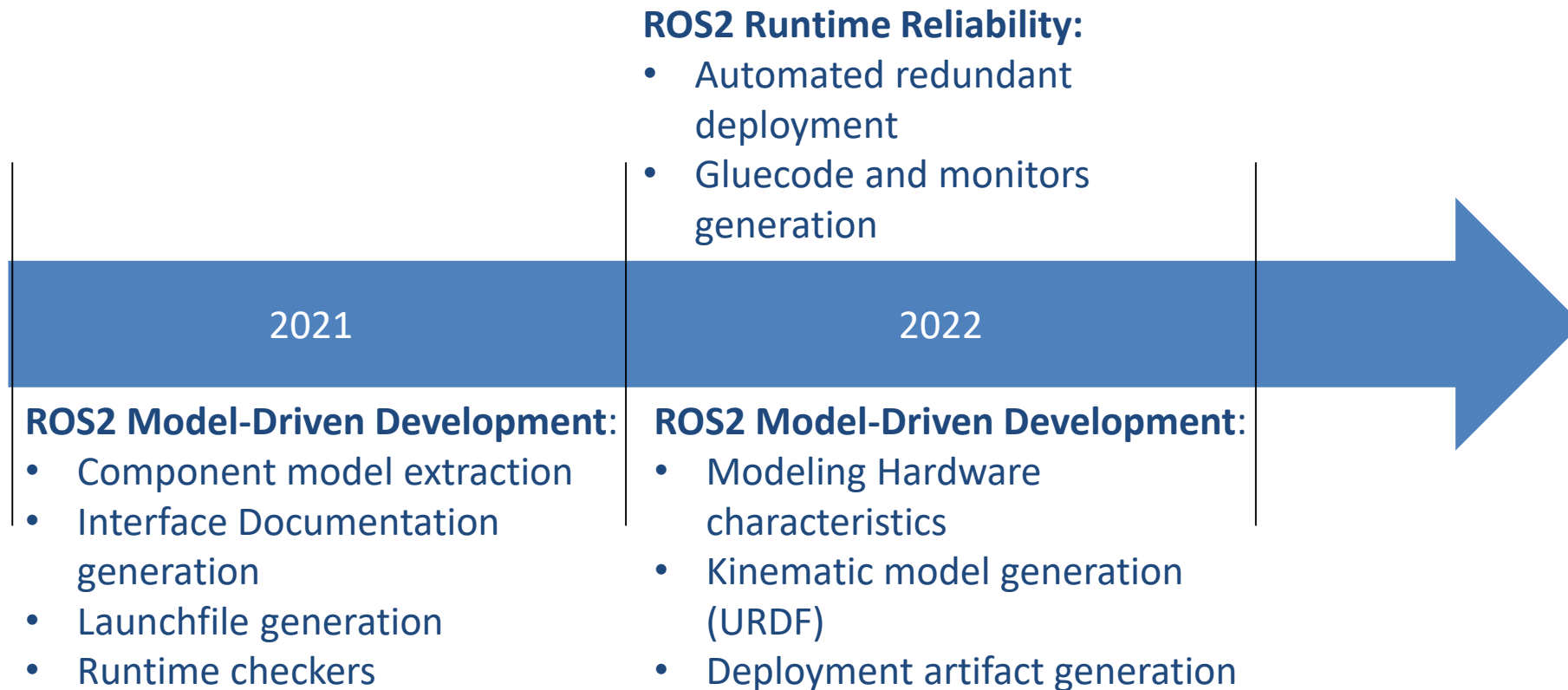


Property Observer



Cognitive Robotics & AI Innovation Center

ROS development roadmap



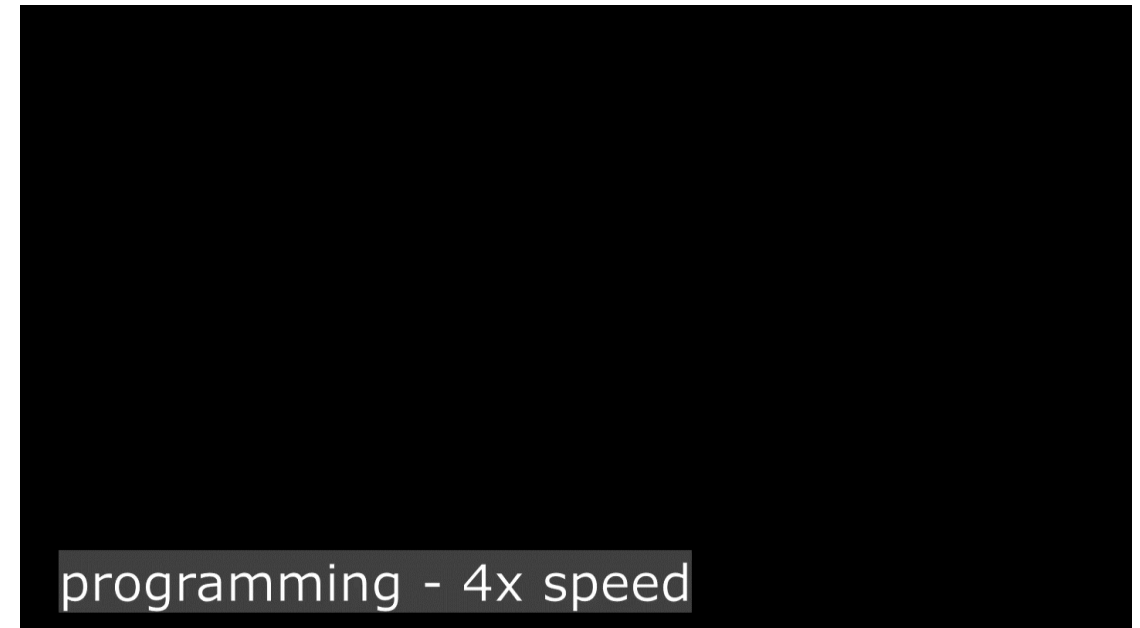
Cognitive Robotics & AI Innovation Center

ROS application development



- Easy programming for welding robots
 - Seam detection
 - Collision-free, optimal path planning
 - Work piece pose detection
 - Easy programming through ROS integration in UR caps

- Want to test?
 - Contact:
Johannes.Stoll@ipa.fraunhofer.de





ROS 2 Industrial Training

More information:

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Description

The ROS 2 Industrial Training teaches the basics of ROS 2 and how to use ROS 2 for manipulation and for navigation. The class is completed by a session of best practices, which teaches how ROS 2 development is done best. The goal of the training is to get all the information needed to start developing with ROS.

Attendees should have basic knowledge:

- ❖ Linux and Terminal
- ❖ Python

Cost:

800€ (Remote), 1200€ (Presence), 0€ (ROS-I Members)

Planned trainings in 2021:

- ❖ ~~09. – 12.03.2021 (Remote)~~
- ❖ ~~18. – 21.05.2021 (Remote)~~
- ❖ 21. – 24.09.2021 (Remote)
- ❖ 16. – 19.11.2021 (TBD)

Agenda

Day	Courses
Day 1 10:00 – 16:30	ROS 2 basic concepts ROS 2 file system ROS 2 terminal
Day 2 10:00 – 16:30	ROS 2 extended concepts ROS 2 handling coordinates with tf2 ROS 2 manipulation basics
Day 3 10:00 – 16:30	ROS 2 navigation basics and localization ROS 2 slam ROS 2 navigation
Day 4 10:00 – 12:30	ROS 2 Best practices

ROS-Industrial Consortium Europe

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70569 Stuttgart, Germany

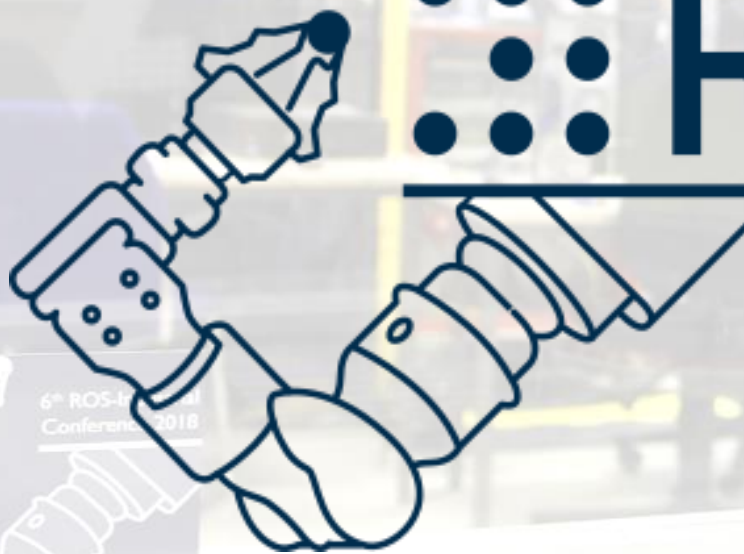




ROS

Questions?

industrial



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