## **Preface**

ROS is developing into the standard middleware for robotics applications. Researchers and practitioners world-wide contribute their results and publish software packages for ROS. This way, a large number of state-of-the-art robotics algorithms become available to be used freely. With the ROS-Industrial project, the ROS success story should be extended to industrial robots as well. To foster ROS-Industrial is also the mission of the ROSIN project (http://rosin-project.eu). In order to build a broad ROS-I community, one of the goals of ROSIN is to teach ROS-I to university students and professionals.

Many institutions offer education activities about the Robot Operating Systems. There are a number of Summer Schools, there are professional trainings for ROS-Industrial and even online courses are available for learning ROS. But how is ROS and, for that matter, how are some of the fundamentals of robotics being taught to the students? With the workshop "Teaching Robotics with ROS" we aim at bringing together educators involved in teaching robotics courses and/or ROS to discuss curricular topics, best practices and exchange about common problems with teaching robotics with ROS.

This volume contains the papers presented at TRROS 2018: Teaching Robotics with ROS (Workshop at ERF 2018) held on March 13-15, 2018 in Tampere, Finland. There were 7 submissions. Each submission was reviewed by at least 2, and on the average 2.1, program committee members. The committee decided to accept 7 papers.

Parts of the workshop organization was supported by the ROSIN project. The ROSIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 732287. We also appreciate the support we received when using EasyChair for the workshop submission handling and in generating the proceedings.

February 25, 2019 Aachen Stefan Schiffer Alexander Ferrein Mukunda Bharatheesha Carlos Hernández Corbato

## **Table of Contents**

Interactive ROS Tutorials with Jupyter Notebooks  Enric Cervera	1
The potential of a robotics summer course on Engineering Education  Nuno M Fonseca Ferreira, Micael S. Couceiro, André Araújo and David  Portugal	12
Hands-on Robotics Teaching with ROS	24
Learning Advanced Robotics with TIAGo and its ROS Online Tutorials .  Jordi Pages, Luca Marchionni and Francesco Ferro	30
Teaching ROS efficiently to mixed skill classes	41
Learning by Doing - Mobile Robotics in the FH Aachen ROS Summer School	47
Teaching Robotics with Robot Operating System (ROS): A Behavior Model Perspective	59

## **Program Committee**

Alexander Ferrein

Stephan Kallweit

Nicolas Limpert

FH Aachen University of Applied Sciences

University of Applied Sciences Aachen

H Aachen University of Applied Sciences

Stefan Schiffer RWTH Aachen University & MASCOR Institute

Patrick Wiesen University of Applied Sciences Aachen