

Fundamentals of Robotics with MyModelRobot

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Abstract. MyModelRobot is an online application for designing and viewing robots described by ROS (robot operating system) supported URDF files [1]. The tool focuses on the simplicity of use, while teaching students the essential ability of describing robots as kinematic trees. Currently, this tool is being used in our normal curriculum, for teaching course in Fundamentals of Robotics. In this paper we report improvements made in the second version of the application and our experiences with two groups of twenty students using this tool. As a modern online application it gives students the ability to do their work in any modern browser, as well as to share their work and easily consult their work with teachers and peers.

Keywords: online simulation, URDF, ROS

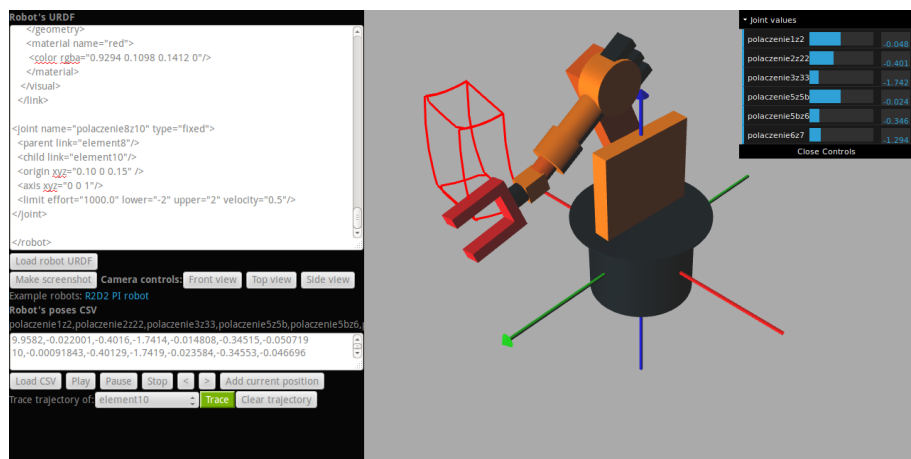


Fig. 1. Screen from MyModelRobot application, showing industrial robot with trajectory of its end-effector, modeled by Lukasz Starzec, Sylwester Kitala and Sebastian Kaluzny

1 Introduction

The Fundamentals of Robotics Laboratory is an important element of the Automatic control and robotics curriculum. By modeling and studying industrial robots, students consolidate their theoretical knowledge and understand what practical robotics means, while still operating in safe simulation environment.

Laboratory is based on the Robotics Toolbox by Peter Corke which is a mature tool for classic robotic topics [2]. It is however quite limited in visualisation of robots, giving only symbolic representation. For that we have used different visualisation tool - RoboWorks, developed in year 2000 and costing 750 USD, by that strongly limiting its use on new computers and at home (because of the licence fee). We are also using some more advanced simulators like Webots, Gazebo, Sim Mechanics and EasyRob but they are much more complex and are practical when complete simulation of robotic scene, sensors and controllers is necessary. Most of them are also licensed, and so available on the limited number of machines, which further complicates usage. This motivated us to design a modern, open and online replacement that would fit our needs.

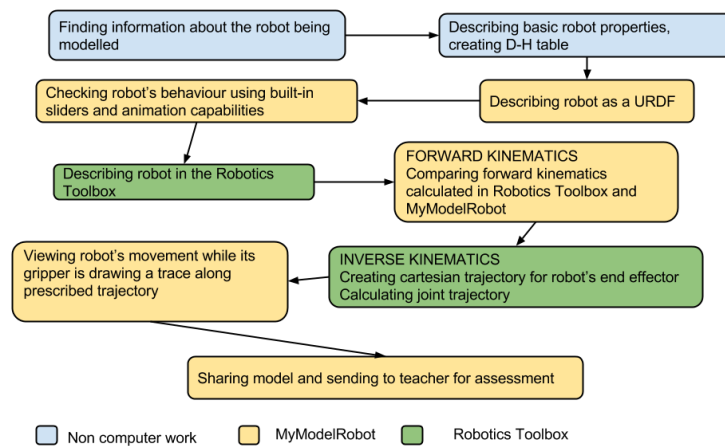


Fig. 2. Diagram showing fundamentals of robotics laboratory course, with tools utilised

2 MyModelRobot

MyModelRobot app was designed as a simple visualisation tool for URDF files used in ROS, now it evolved to an online modeling, visualisation and animation tool (see screenshot in Fig.2), that allows:

1. **modeling and visualisation of URDF files.** Our program allows for visualisation of URDF files, that describe kinematic and dynamic properties

- of robots, without the need to install Linux's ROS, Rviz or Gazebo. ROS is increasingly used in other, more advanced labs in offered curricula and familiarity with its modeling format makes ROS introduction easier.
2. **interactive robot control.** While modeling robots, there is a need for a simple visual feedback, to make sure that the robot behaves correctly. Our application automatically generates controllers for all rotational and prismatic joints described in URDF.
 3. **animation and trajectory visualisation.** MyModelRobot enables easy animation of robots, using poses described in csv files. Files can be generated by recording sequences of poses in the application itself or by using an m-file converting joint trajectory generated in the Robotic Toolbox to a file read by MyModelRobot. The trajectory of of any part (link) of the robot's model can also be visualised which is important in checking results of inverse kinematics generated in Matlab.
 4. **full online access and sharing capabilities.** MyModelRobot is a free to use and publicly available (<http://www.MyModelRobot.appspot.com>). There is no plugin needed and it works on all modern browsers. This allows students and other users to work from home as well as to share (3D models and trajectories, in editable and locked modes) with teachers but also friends, collaborators and family, providing motivation for work.

3 Results

MyModelRobot was used to model industrial robots basing on their datasheets. Using Robotic Toolbox, students then calculated forward and inverse kinematics and generated trajectories that could be viewed in MyModelRobot and shared with other students and teachers. Students responded in survey that the new tool was easy to use and understandable. They have also completed approximately the same amount of tasks as with the previous tool.

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References

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