Industrial robots are used in different application fields. Many manufacturers are active on the market with their robots and software for robot programming. In most cases the software solutions are manufacturer-specific and cannot be used for other robots. Long term standardization efforts for explicit robot programming, such as the IRC (Industrial Robot Language) and its successor, the PUR (Programming Language for Robots), have been mostly ignored by robot manufacturers. This fact leads to a restriction on the continued usage of robots from different manufacturers or makes it even impossible. Multi-robot applications, where robots have to interact, are mostly limited to the software solution and robots of one manufacturer.

Control model design in the engineering and scientific domain is often characterized by the usage of Scientific and Technical Computation Environments (SCCEs) like MATLAB. The Robotic Control & Visualization (RCV) Toolbox for MATLAB closes the gap between robot manufacturer-specific programming languages and SCCEs. The current version of the RCV Toolbox for MATLAB supports control development for KUKA and KAWASAKI robots. However, an extension to other robots is straightforward.

Research in robotics is proceeding rapidly and new fields of application for robots are made up continuously. The requirements concerning robot control development are increasing, too. Easy programming and integration of various external hardware (sensors, actors) are of particular importance. In this context, it is desirable to have a homogeneous software environment from the early control design to operation phase (Rapid Control Prototyping). The RCV Toolbox for MATLAB provides an efficient way to realize these requirements in practice.

- One Control-Program for interactive robots of different manufacturers
- Easy, manufacturer independent integration of external hardware

**SOFTWARE STRUCTURE OF RCV TBX**

- Control Commands
  - rbrake(...)
  - rgo(...)
- Visualization Commands
  - VirtualRobot.delete_all...
  - VirtualRobot.start_all...
- Visualization Interface
  - VirtualRobot.repose_env
  - VirtualRobot.repose_part
- Current Available Interpreters
  - Serial: Kuka KR2
  - TCP/IP: Kawasaki FSSC3N
  - Kuka Agilus KR6

**USAGE OF RCV TBX**

Kuka KR2 robot is connected via serial interface RS232. Kawasaki FSSC3N and Kuka Agilus KR6 are connected using TCP/IP. One instance of MATLAB can control different types of real and virtual robots at the same time. The control program for a heterogeneous multi-robot system can be developed using all available MATLAB tools.

**STATE OF THE ART & APPROACH**

One Control-Program for interactive robots of different manufacturers

**CONTROL DEVELOPMENT USING RCV TBX AND MATLAB/STATEFLOW**

The RCV Toolbox distinguishes between three object types. The central part are objects of type ROBOT, which are interacting with objects of type PARTS. ENVIRONMENT objects are passive and cannot be moved by a ROBOT object.

**SIMULATION BASED CONTROL (SBC) FRAMEWORK USING RCV TBX**

The SBC framework is a computer aided development methodology for discrete event controls. The SBC is based on the concept of Rapid Control Prototyping (RCP). An essential aspect is the continuous usage of simulation models during the entire control program development.

**EXAMPLE: MULTI-ROBOT SYSTEM USING SBC FRAMEWORK & RCV TBX**

The application consists of three interacting robots using geometric coupling (bad sharing).

**CONTACT**

M.Eng. Birger Freymann
Prof. Dr. Thorsten Pawletta

http://www.mb.hs-wismar.de/cea/