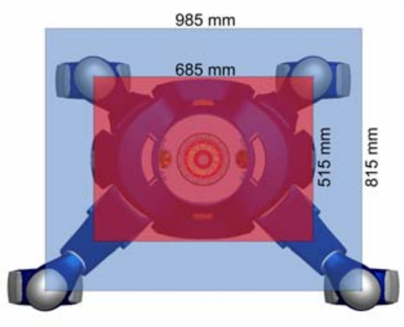
Deutsches Zentrum
für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

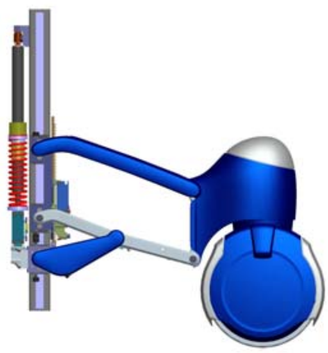
Handout

# "Rollin' Justin"
# - Mobile platform with variable base -

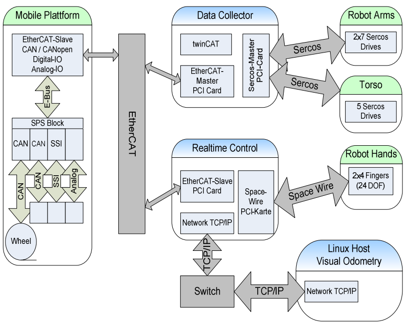
The Rollin' Justin




Mobile base



Leg mechanics




Realtime communication

The mobile robotic system Justin with its compliant controlled lightweight arms and its two four fingered hands is an optimal experimental platform for the study of complex manipulation tasks. The newly developed mobile platform allows the long distance autonomous operation of the system. It pushes the system forward towards an universal service robotic platform.

## Mechanical construction

***Variable base:***
An extendable robot base is required In order to take advantage of the large workspace and the dynamics of the upper body Justin, while providing the stability of the overall system. Contrary, for a reliable and easy navigation in household environments compact dimensions are necessary.
The individually movable legs of the mobile platform enable Justin to use its full workspace and its dynamics for manipulation tasks. Additionally, simple and reliable navigation through narrow passages, like usual household doorways, is possible.

***Spring mounted chassis:***
In order to stand up straight with four wheels on uneven ground and to gently drive the upper body over small obstacles like doorsteps, the wheel suspensions are individually spring damped. The dampers are equipped with a locking device to provide a very high stiffness of the platform during the execution of fine manipulation tasks with the upper body.

## Power supply

The whole system is powered by a Lithium-Polymer battery block with 48V nominal voltage and 40 Ah. To support the individual robotic components, sensors and computers the main power supply is divided into six separated power lines (48V, 3x 24V, 12V, 5V).

## System design

The development of the mobile platform followed three main requirements:
1. Functional needs
2. Compact construction
3. Usage of off-the-shelf components

lThese demands are challenging for the system design and the real-time communication concept which must cope with different real-time protocols and bus systems. The robotic system makes use of components that communicate via EtherCAT, CAN, CANopen, SERCOS and SpaceWire. These different field busses are joined using the standard software TwinCAT and mapped on a single EtherCAT slave. On the separate real-time computer running the control of the whole upper body and the mobile platform all robot data is available through a single real-time protocol. The data is provided in a Matlab/Simulink environment to allow rapid prototyping of the control system for the whole robot platform.An additional pc running Linux is used for 3D- vision.

## Technical Data:

*Dimensions:*

| | | |
|---|---|---|
| Length | (min/max) | 685 mm / 985 mm |
| Width | (min/max) | 515 mm / 815 mm |
| Height | | 700 mm |

*Mass:* ca. 120 kg

*Power supply:*
Lithium-Polymer 40Ah / 48V
Operating time > 1h

*Actuation:*
Driving: 30Nm / 1,5 m/s (5,5 km/h)
Steering: 360 °/sec

*Sensors:*
4 x ToF Cameras (60 x 54 Pixel)
2 x GigE Camera (640x480, 90fps)
4 x Force sensors
8 x Absolut encoders (wheel position)
8 x Bumper + 4 x emergency stop

*Computers:*
4 x Mini-ITX Core2Duo M / 2.16 GHz

**Deutsches Zentrum**
**für Luft- und Raumfahrt** e.V.
German Aerospace Center

Institute for Robotics and Mechatronics
Münchner Str. 20
D-82234 Weßling

Dipl.-Ing. (FH) Matthias Fuchs M.Sc.
Phone: +49 8153 28 -2440
Fax: +49 8153 28-1134
Matthias.fuchs@dlr.de
www.DLR.de