TAČR: Advanced Robotic Architectures for Industrial Inspection
(ADRA-2I)

Project number: TF02000041

Real time simulation models

([Gprot] Real-time simulační modely - HIL)

(Czech pilot)

D10. (NTIS, ZSU) Real time simulation models - HIL

(Hardware)

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10 February 2018

Description:

Real-time HIL simulator for developed multi-redundant robot ROBIN is supposed to be used for verification of the functions of implemented control system without necessity to have the real robot prototype. All implemented algorithms of the control system can be safely tested on the virtual simulation model (Matlab/Simulink/SimMechanics).
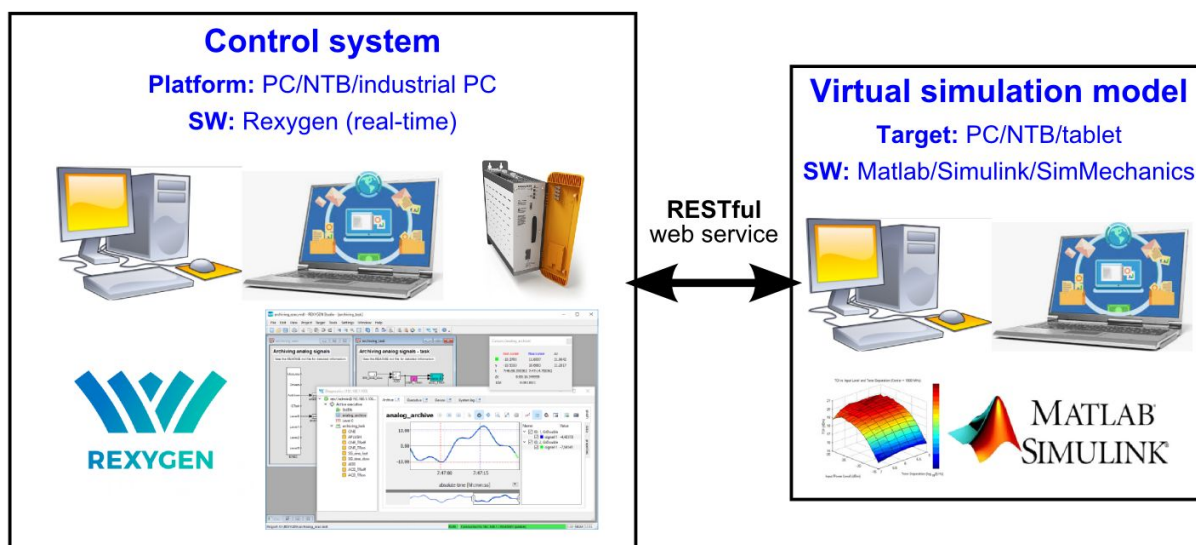

Layout of the HIL simulator

Key features:

- Verification of the real-time control algorithms via robot virtual simulation model
- Configurability of the virtual simulation model (eg. adding joints, change links length, etc.)
- Visualization of tracking trajectories of the end-effector
- Measurement of interested variables (e.g. joints position/velocity/acceleration)

Verified functions of the ROBIN multi-redundant robot via HIL simulator:
- Joints JOG functions
- Coordinate end-effector JOG functions (World, Tool, Special JOGging mode for cylindrical coordinates, etc.)
- Optimal motion verification (visualization of the objective function values): joints limit, overcoming, obstacles avoidance
- Auto-align algorithms of NDT probe for pipe surface moving (auto-align + JOGging in cylindrical coordinates)
- Visualization/verification of the robot links obstacles collisions (verification of the robot optimal obstacle avoidance)
- Verification of generated meander motion of the end-effector
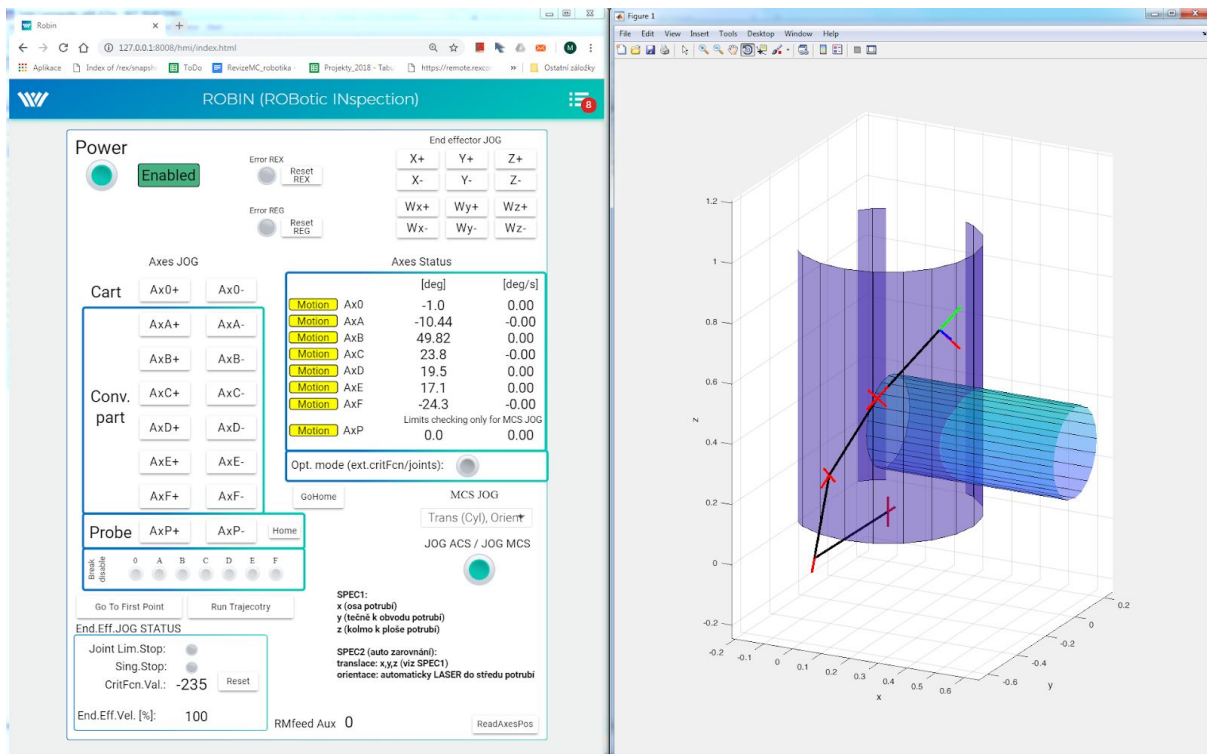
HMI of the Real-time control system (left) and visualization of simulation model (right)

Realization of the prototype:

- **Real-time robot control system implemented in software REXYGEN**
  - Signal processing, motion and logical control, communication, logging, etc.
  - HMI/visualization for robot system configuration, programming and guidance
  - Configurable communication layer (interface) for
    - a) Real servo-drive units + additional peripherals (EtherCAT, CAN, USB HID, etc.) => Real robot configuration
    - b) Virtual simulation model (RESTful web service) => Hardware In the Loop configuration
  - Target platform: PC/industrial PC
- **Virtual simulation model implemented in Matlab software**
  - Robot visualization via Matlab figure plot
  - Virtual simulation model via Simulink/SimMechanics (optional)
  - Verification of the robot properties using implemented functions (scripts, m-files) for:
    - Direct/inverse kinematics
    - JOG mode (axes/end-effector)
    - Optimal multi-redundant robot moving
    - Etc.
  - Target platform: PC/NTB

Contact / availability:

For more information please follow the references:

1. D16. Robotic prototypes documentation, [O] Dokumentace prototypů (výsledek č. TF02000041-V4)

2. Promo materials:
   https://drive.google.com/drive/folders/1eO87Mt2gaR0uDu_UEs12Ukr6dYmB00kb?usp=sharing

The results are available at:
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Or can be obtained on request from ntis@ntis.zcu.cz

Acknowledgment