



Challenge 1

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Challenge 1 – Motivation and RTD Issues

Reconfigurable Interactive Manufacturing Cell

● Motivation

- Develop **innovative manufacturing solutions** that benefit the European industry
- Push the state of the art in manufacturing technologies
- Use and showcase the potential of robotics challenges

● Research focus

- **Adaptive perception and cognition skills** in presence of complex workcell layouts and dynamic environments, illumination changes and tolerances
- **Robust assembly skills** in presence of part tolerances, flexible parts
- **Safe and productive human robot interaction** in presence of ambiguous situations, tight workplaces
- Methods to control robustly **multi-role and multi-arm cooperative robotic systems** in an industrially relevant setting

- **Fraunhofer IPA supplies large set of platform components**
 - **Automation** – robots (UR5/UR10, Kuka LWR, Kuka KR16), light curtains, suction and fingered grippers, 2D and 3D cameras, IO-modules, S7 safe PLC, force torque sensors
 - **Mechanics** – fixtures, tables, clamps, etc.
 - **General infrastructure** – computers, network
 - Further components from the teams can be integrated if needed
- **Software interfaces**
 - **ROS** compatible interface of most supplied components
 - Proprietary interfaces (however not supported)
- **Location of the platform**
 - IPA lab or ARENA2036 site (both in Stuttgart)

Challenge 1 – Platform components



Challenge 1 – Platform



- **Onsite support for the challengers**

- Hardware setup (mounting, dismounting, tools etc.)
- Software integration of the platform components
- Mechanical and electrical workshop and 3D printers can be accessed in case that some mechanical/electronic parts/adapters are needed



- **Challenger platform introduction day**

- Event in Stuttgart where the platform components, their functionalities and how to integrate and use them are explained in more detail



Challenge Stages



Challenge 1 – Stage 1: Qualifying

● Focus on

- Visual perception and analysis of human activity and localization of industrial objects
- Guaranteeing human safety while keeping up productivity
- Force torque controlled operation of a dual arm robot

● Two application scenarios

- 1st: interactive teaching of a riveting process, coping with uncertainties
- 2nd: force controlled peg insertion into a hole using a dual arm robot

● Evaluation

- Solutions have to be submitted (executable)
- Automatic evaluation of the solutions under equal conditions
- The 15 highest scores will advance

Challenge 1 – Stage 2: Realistic labs

- **General Focus of the stage**

- Improvements wrt. current solutions at end users' sites regarding Safety, Interaction, Teaching, Assembly processes, Coping with uncertainties

1. Benchmarking task

- Car door module assembly
- Same setup for all teams (table, robot, gripper, FT-sensor, cameras, fixtures)

2. Freestyle task

- TBD by challengers
- Challengers can start from T1 initial setup or design their own

3. Showcasing task

- TBD by end user
- Challengers can start from T1 initial setup or design their own

Challenge 1 – Stage 2: Realistic labs

● Benchmarking task – car door module assembly



aligned holes of door and module ready for screwing

● Challenge

- Partially flexible parts
- Inaccurate feeding
- Part tolerances
- Variants of door/module

● Evaluation criteria

- quantity of door modules assembled
- quality of the assembly
- Failure rate
- Switchover time for known and unknown alternate door

Challenge 1 – Stage 2: Realistic labs

● Platform access

- Platform introduction day at Fraunhofer IPA
- 4x 1 week platform access for each team
- Locally assisted by Fraunhofer IPA

● Evaluation

- Midterm evaluation regarding benchmark and showcasing at Fraunhofer IPA by independent experts
- Final evaluation at challenge workshop at Fraunhofer IPA in Stuttgart
- Objective ranking through Challenge Advisory Board and independent experts

Challenge 1 – Stage 3: Field tests

● Task

- Will be defined jointly with the end user
- Transfer of general solutions from Realistic Labs stage to end user site
- Focus on industrial requirements like robustness, cycle time and reusability

● Platform access

- Platform can be used up to 4 weeks for preparations and tests at Fraunhofer IPA
- Components have to be returned after end of challenge (or be bought at cur. value price)

● Evaluation

- Final evaluation by independent experts at end user site
- Media presentation of results to the public at final challenge workshop at Fraunhofer IPA in Stuttgart



Challenge 1 – Contact



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