1st ADAPT workshop

Advanced Agile Production

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Agenda

1:00 PM – Introduction and schedule; Roel Pieters, TAU

1:10 PM – METRICS introduction; Guillaume Avrin, LNE

1:30 PM – ADAPT Competition; Roel Pieters, TAU

1:50 PM – ADAPT Field campaign; Max Pfingsthorn, OFFIS

2:10 PM – ADAPT Cascade campaign; Farzam Ranjbaran, CEA

2:30 PM – Stakeholder discussion

3:00 PM - Closing

ADAPT Field Campaign

The ADAPT Field Campaign is a **physical, open platform** competition for agile production.

Participants are encouraged to bring their **own robot and sensor** setups, though a fairly standard setup is provided as needed and as a fallback.

Participants are expected to **record and submit sensor data** during the functional benchmarks, including relevant meta-data (calibration, etc.), and annotate it as possible. This is to provide a growing database for the cascade campaign.

Two Parts:

- Functional Benchmarks
  - Focusing on **supportive** functionality, such as object detection
- Task Benchmarks
  - Focusing on **integrated** functionality, i.e. the assembly process

Robot System Constraints

Constraints on participating systems:

- Minimum System Components
  - Manipulator with gripper
  - Calibrated RGB or RGBD camera
- Maximum physical extends
  - 0.7m x 1m footprint, must fit through standard doors
  - 100kg maximum weight, with wheels if more than 30kg
  - Single 230v power connection

Otherwise Open!
Creativity encouraged!

Recorded data must be submitted as ROS bag files, the specific minimum structure (topic names, types) is TBD. ADAPT will publish scripts to check conformity.

Functional Benchmarks

- FBM1: Detection and Classification of Parts
  - Focus on classical object detection, bounding box/segmentation based
- FBM2: Pose Estimation of Parts
  - Focus on precise localization, including rotational symmetries, e.g. for grasping
- FBM3: Quality Control of Final Assembly
  - Focus on classification of assembly anomalies given a certain expected assembly progress

Some overlap with Cascade Competition (next presentation), but focus on in-person evaluation with participant-supplied data.

Task Benchmarks

- TBM1: Collaborative Programming for Assembly
  - Focus on provisioning of the collaborative application given CAD models, the physical objects, and assembly instructions
- TBM2: Collaborative Assembly of Complex Parts
  - Focus on performing the assembly collaboratively with the robot system

FBM1: Detection and Classification

Given

- Object descriptions (CAD, training images, etc.)
- Class labels

Expected Outcome

- Detect bounding box in table space
- Estimate object class

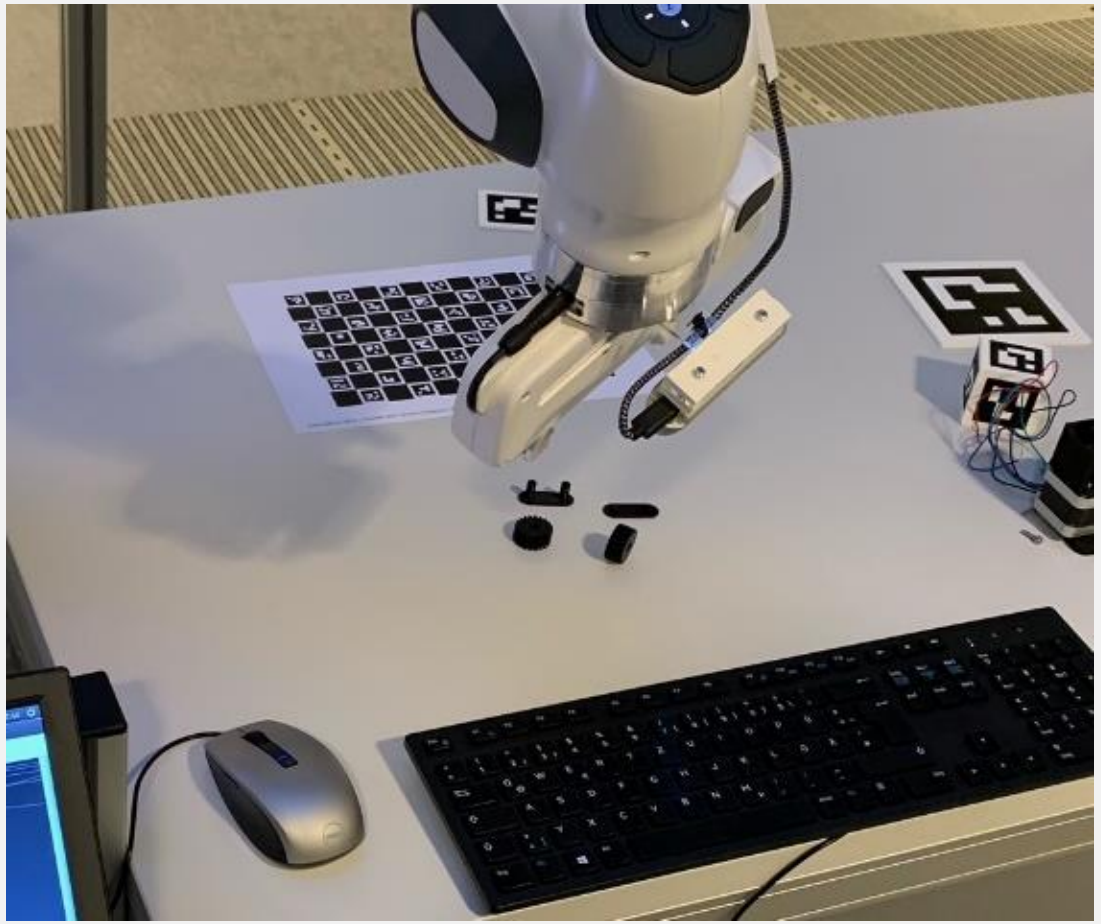
FBM2: Pose estimation

Given

- Object descriptions (CAD, training images, etc.)
- Object reference coordinate system

Expected Outcome

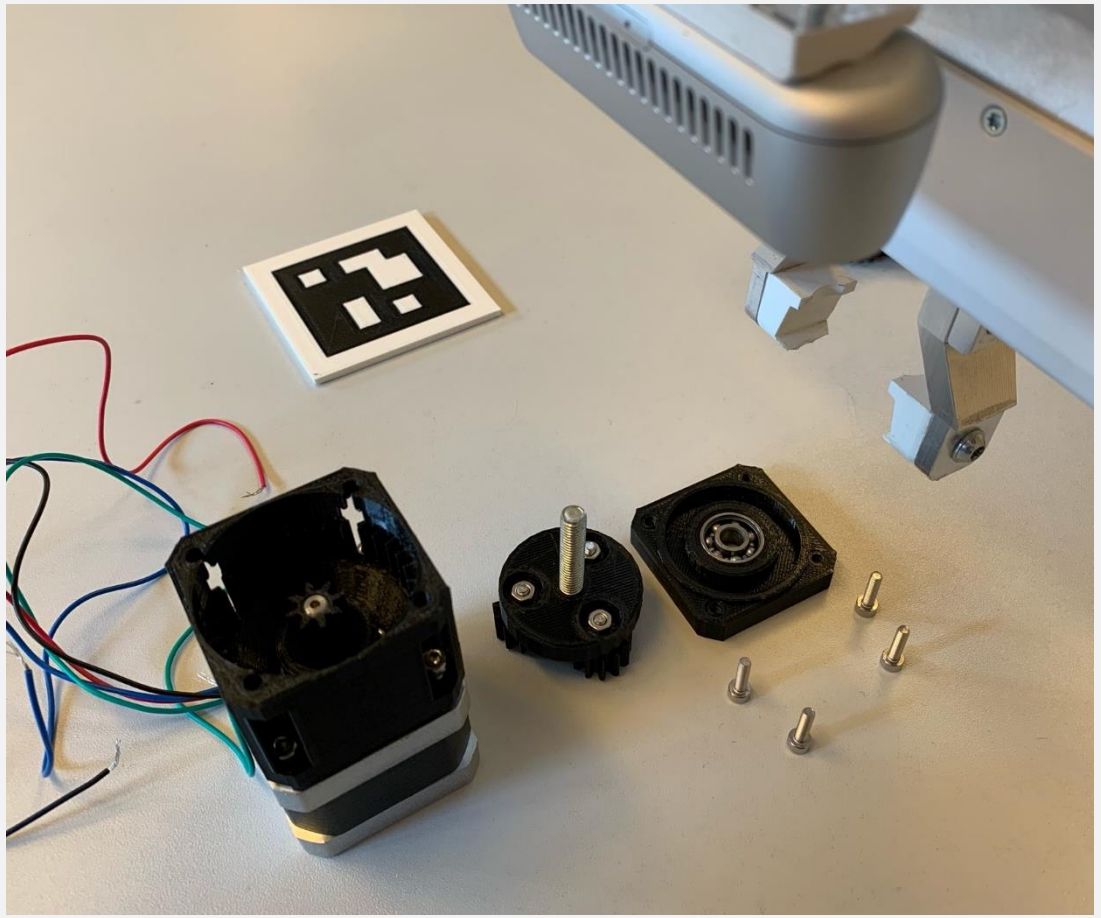
- 6D pose of the detected object(s)



FBM3: Quality Control

- Given
- Description of subassemblies (CAD)
- Description of final assembly (CAD)

- Expected outcome
- Classification of correctness (SUCCESS, FAULTY, INCOMPLETE)
- Estimate of completion (e.g. 3



TBM1: Collaborative Programming

Rationale: (Semi-)Automate quickly

Given

- Description of **novel** simple assembly (CAD)
- Assembly steps (instructions)

Expected outcome

- (Semi-)automated assembly capability

METRICS

- Number of assembly steps automated successfully
- Number of assembly steps done collaboratively
- Correctness/Completeness of final assembly
- Time to Completion

TBM2: Collaborative Assembly

Given

- Description of novel complex assembly (CAD)
- Assembly steps (instructions)

Expected outcome

- Finished assembly, done collaboratively

METRICS

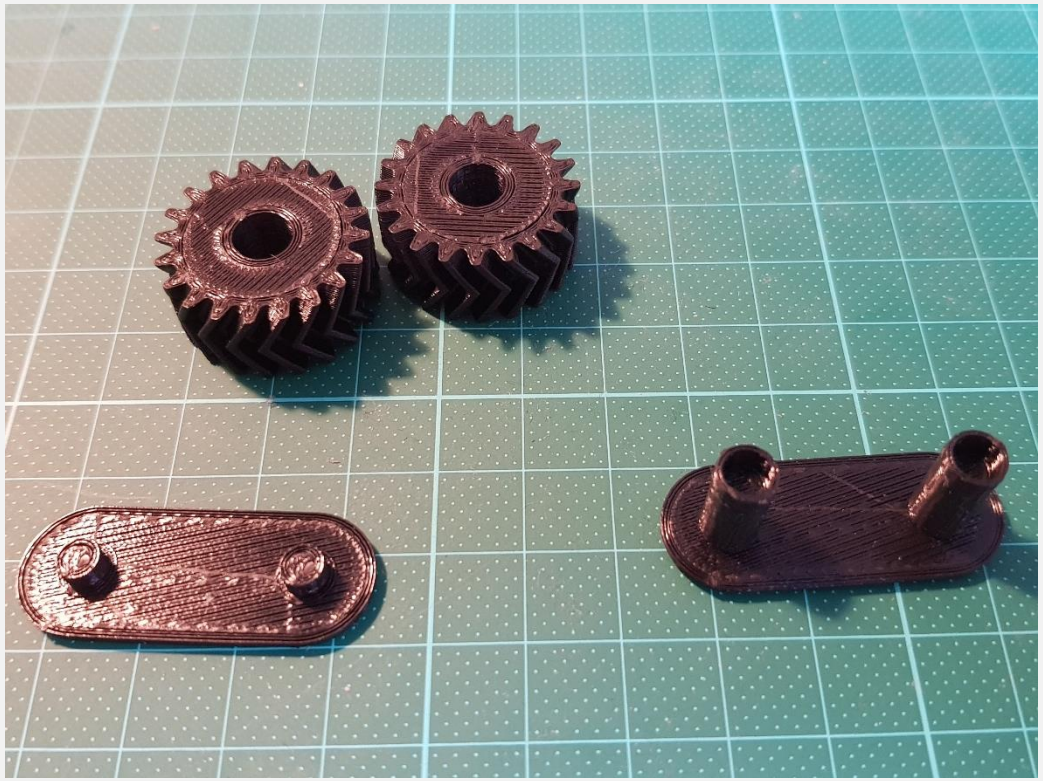
- Number of assembly steps done collaboratively
- Correctness/Completeness of final assembly
- Time to Completion

Rationale:

Leverage Cobot as a Tool

Example Assemblies

Simple Assembly (TBM1)



Complex Assembly, 34 parts (TBM2)

Example Assembly Instructions

Build instructions for the Helical Gear

Components

2x Gears | 1x Top casing | 1x Bottom casing

Step (1)

Connect the two gears

Step (2)

Insert the Bottom casing into the Helical Gears

(3)

he object around and insert the Top casing

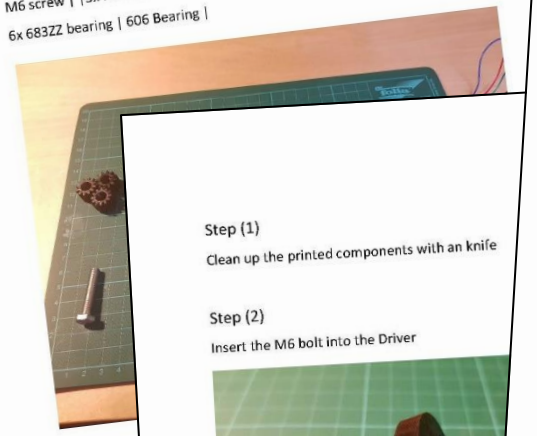
Build instructions for the Planetary Reducer

Components

3x Planetary Gear | Housing | Top | Driver | Stepper motor | Sun Gear |

M6 screw | |3x M3x14 screw | 6x M3 nuts | 8x M3x12 screw |

6x 683ZZ bearing | 606 Bearing |



Step (1)

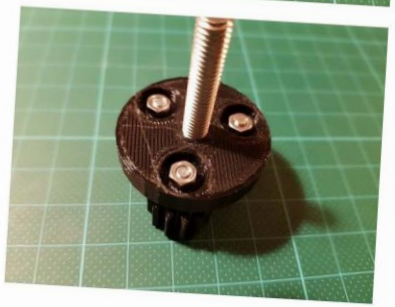
Clean up the printed components with an knife

Step (2)

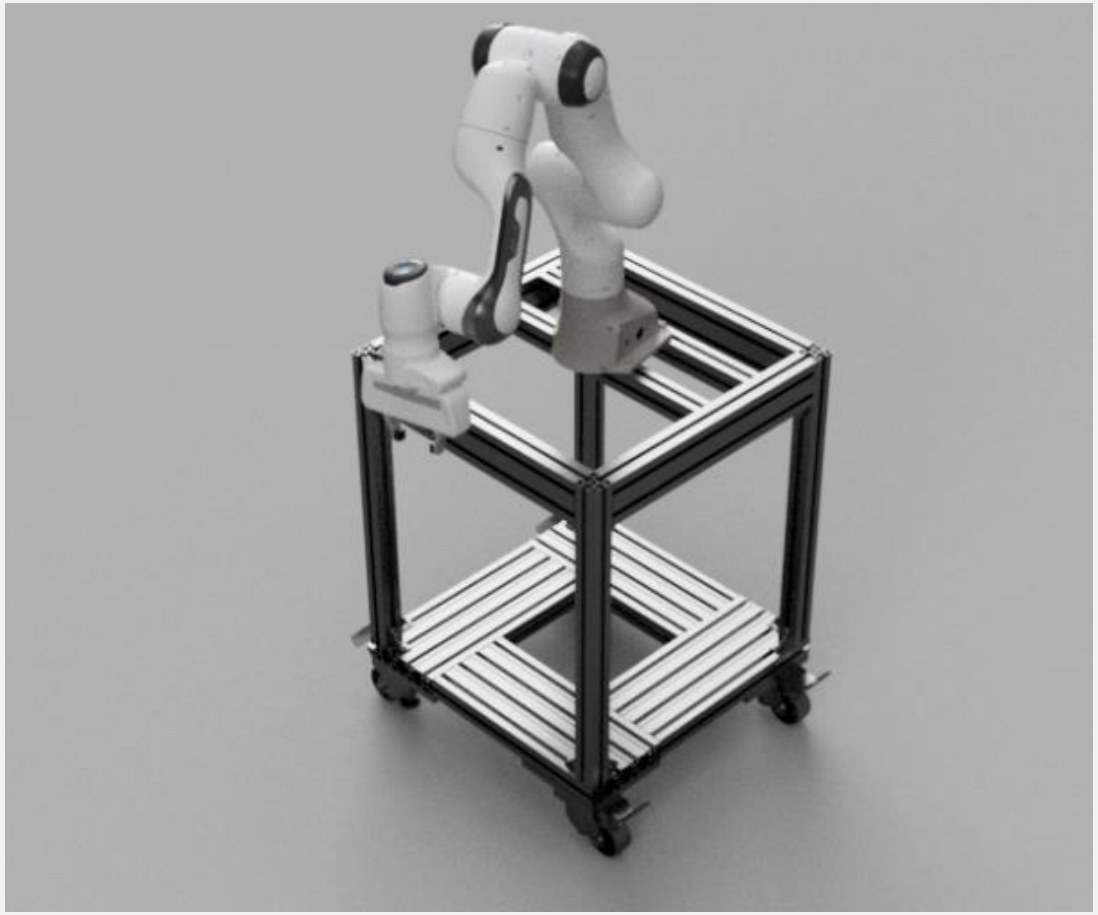
Insert the M6 bolt into the Driver

Step (3)

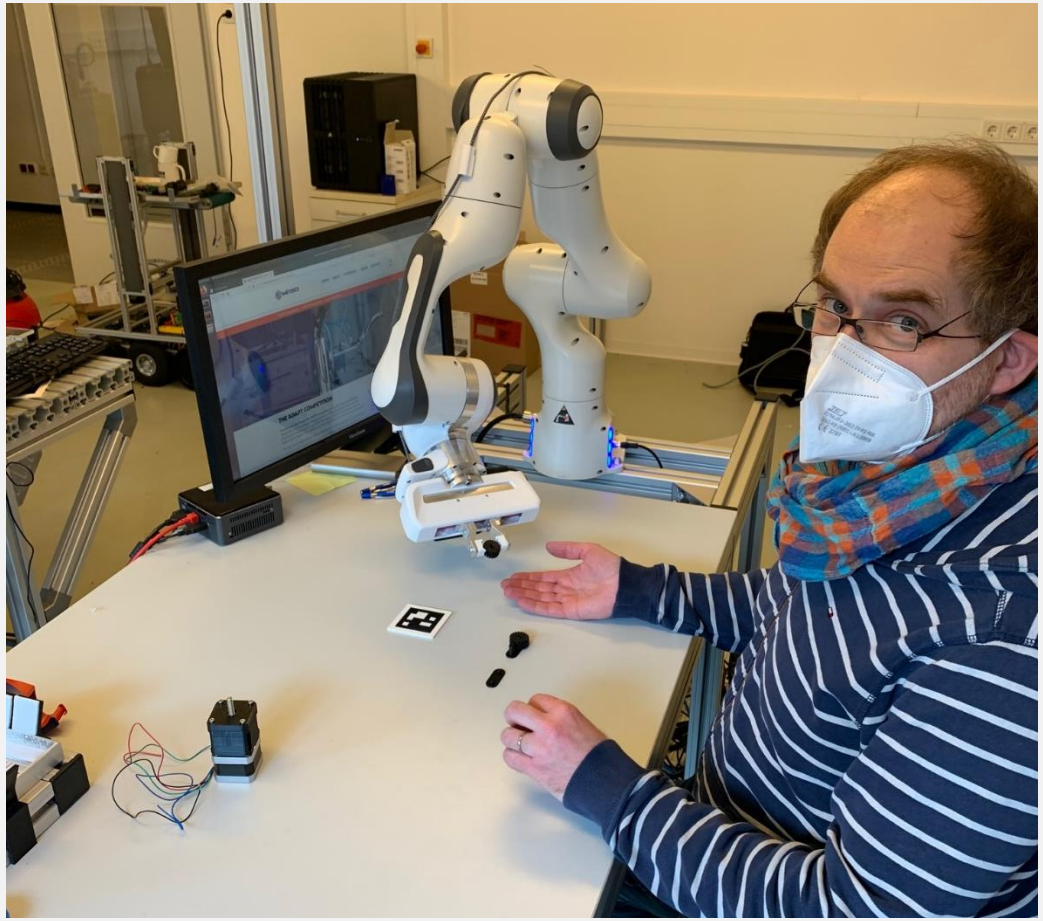
Insert the Bearings on either side of the Planet Gear and fasten the Planet Gears onto the Driver with M3 screws and nuts

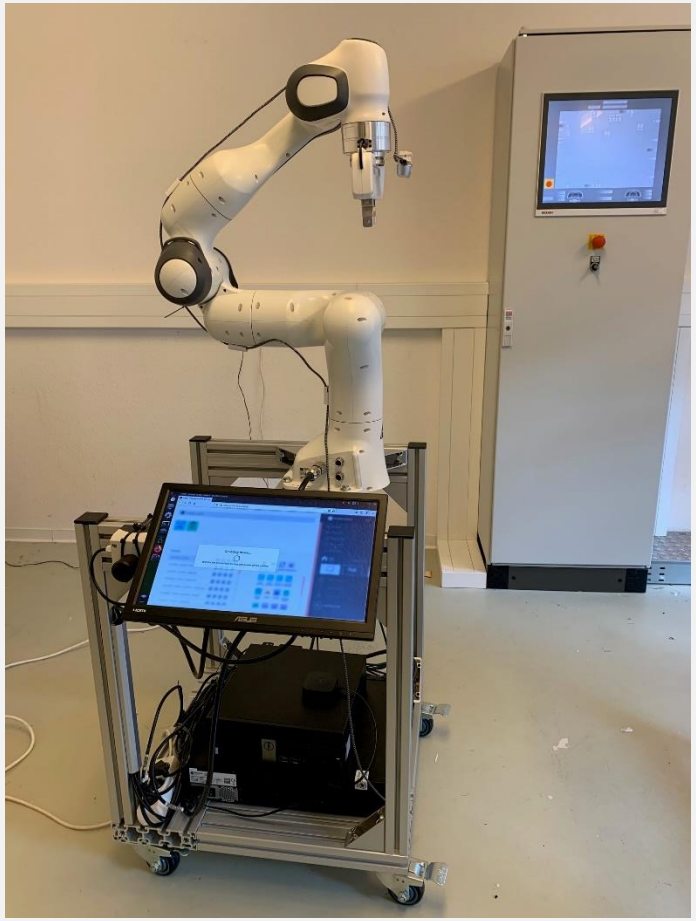


Example Competition Environment



Competition Environment Prototype





THANK YOU

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