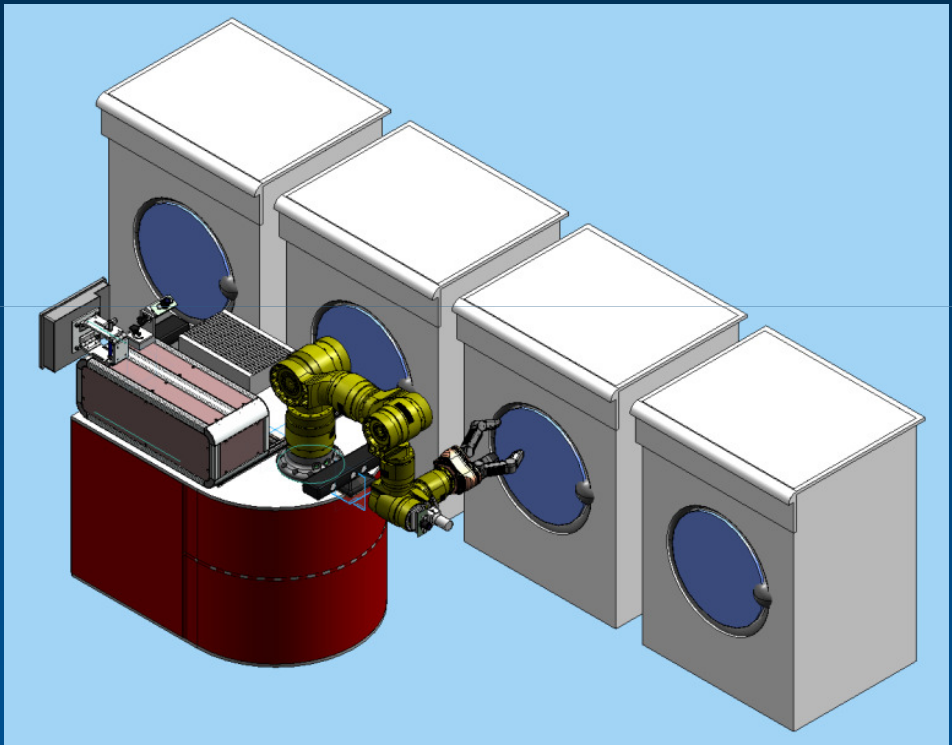
LOCCIONI

InterAID

Fraunhofer IPA

Interactive Mobile Manipulators for Advanced Industrial Diagnostics



Dr.-Ing. Dipl.-Inf. Birgit Graf
Fraunhofer IPA
birgit.graf@ipa.fraunhofer.de

European Clearing House
for Open Robotics Development
www.echord.info

ECHORD

Application case

Reliability and life test laboratories of house hold appliances
(e.g. washing machines factory)

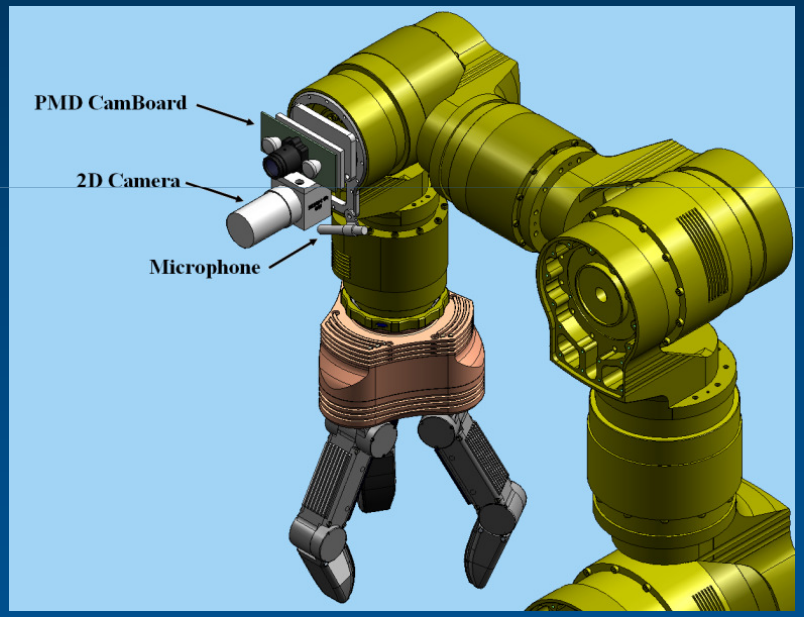
Application case

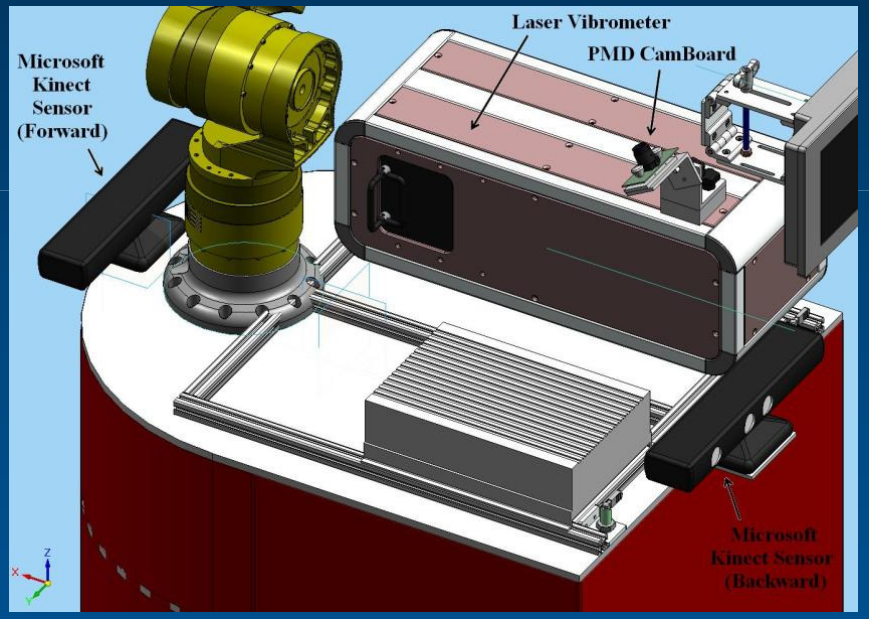
- 0,1% of the production is currently tested in the life test laboratory
- Machines work for many cycles in order to simulate their working life (250-500 cycles)
- Operators are responsible to switch washing machines on and off and to load them with laundry
- Some quantities are measured for each machine automatically (energy absorption, water consumption, number of cycles)
- Additional parameters like machines vibration and noise are checked by the operators
- Installing additional measurement sensor to check these parameters automatically would be too expensive

Experiment goals

- Mobile diagnostics robot
  - automatically executes manual checks and operations
  - thus allows to relieve the operators from these repetitive tasks
- Sub goals / tasks
  - Design and integrate advanced mobile manipulator with 7 DOF arm and hand as well as several 3D environment and application sensors
  - Implement advanced environment modelling system allowing collision-free navigation and arm movements in a human robot co-worker scenario
  - Implement advanced diagnostics functions, e.g. suitable movements to position application sensors, analyze application sensor data

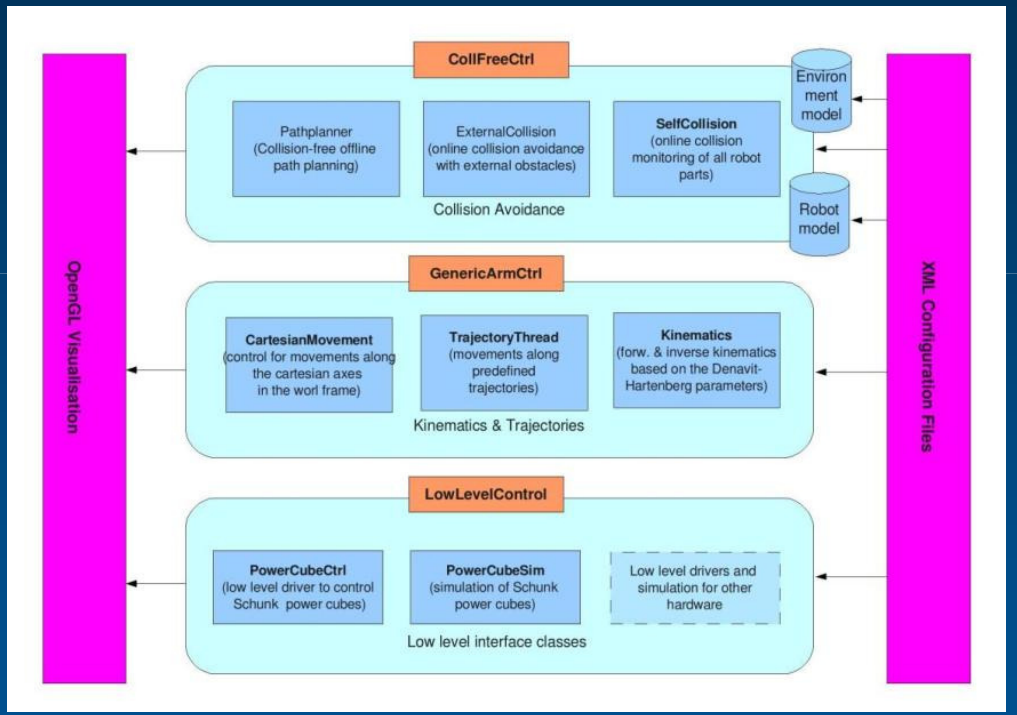
Advanced mobile manipulator





Advanced mobile manipulator

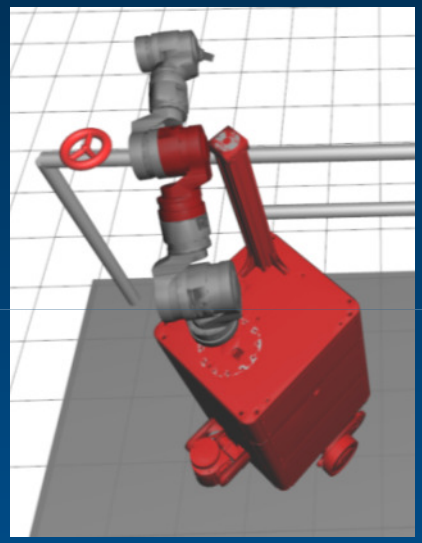
Background Knowledge Fraunhofer IPA

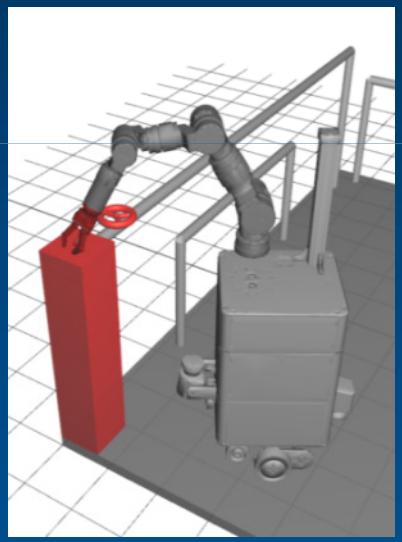


Technology transfer: arm control

Collision free arm motion in static environment

- Modelling of robot and environment by means of oriented bounding boxes (OBBs)
- Continuous update of robot position and arm configuration
- Checking and avoidance of self collisions and collisions with the environment

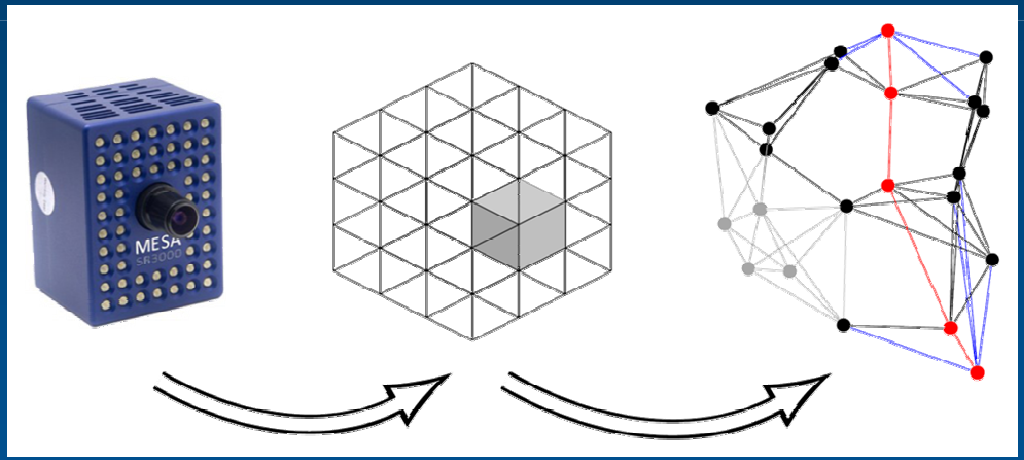




Technology transfer: arm control

Collision free arm motion in dynamic environment

- Offline pre-processing of self-collision free roadmap
- Mapping between discretized workspace and roadmap
- Remove blocked parts of the roadmap online
- Connect start and goal configuration to roadmap
- Search reduced roadmap



Knowledge transfer: 3-D environment modelling

- Target: identify obstacles relevant during manipulation
- They may also be out of the sensor's field of view
- Therefore: Assembly of a consistent 3-D point map during robot movement
- Method: Detect 3-D SURF features in consecutive images, use them together with odometry to register point clouds