

# Puresafe contributions to telerobotics

## WP2 and WP3 results

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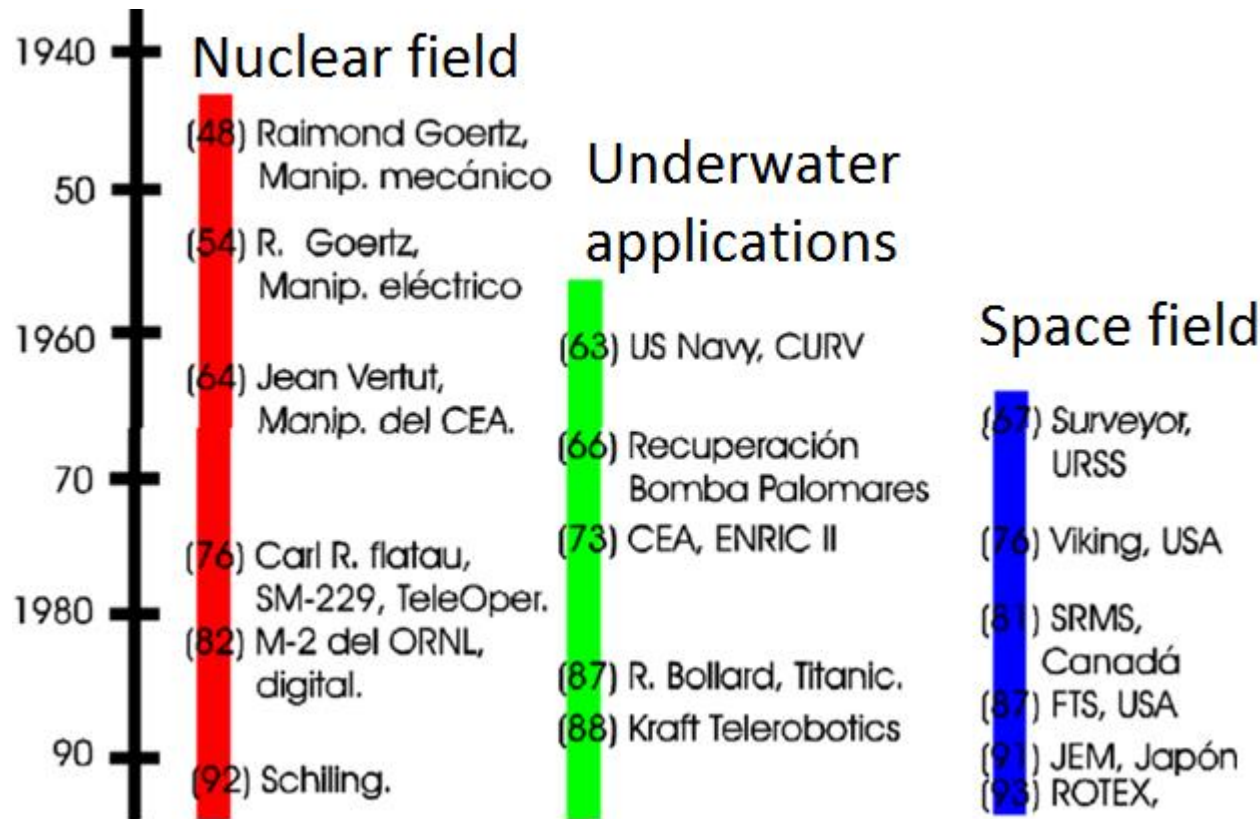
# Outline

- Main challenges in telerobotics
- Puresafe WP2 contributions
- Puresafe WP3 contributions
- Conclusions



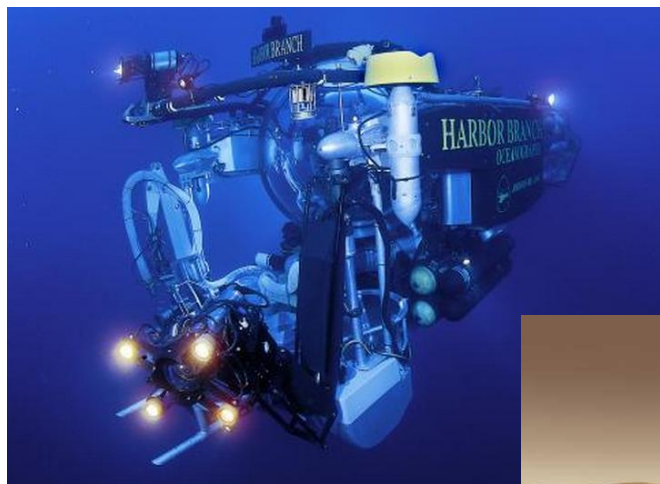
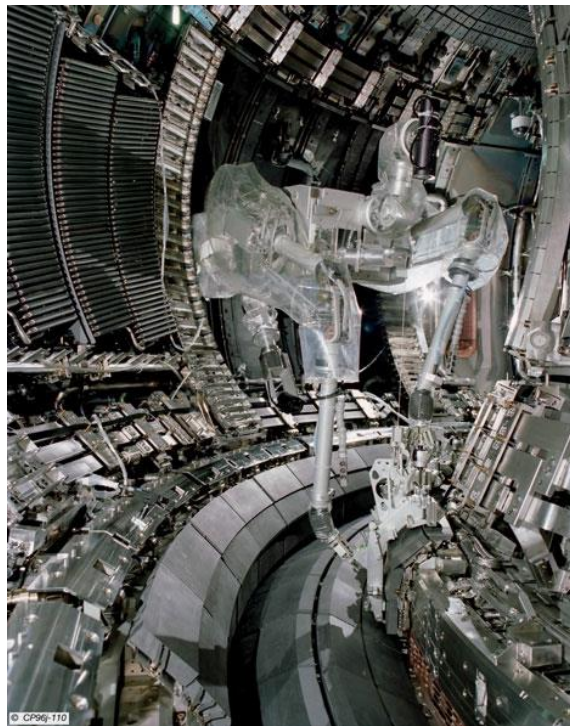
# Main challenges in telerobotics

- Telerobotics historical evolution



# Main challenges in telerobotics

- Transferring technology:
  - From applications with HIGH risk environments to  
-> MEDIUM / LOW risk environments



# Main challenges in telerobotics

- MEDIUM / LOW risk environment features:
  - Operator use special protections to perform safety procedures
  - Challenge: improve productivity by telerobotic technologies (time and cost)
  - Key point is the balance between Operator and computer role. Ideal goal:
    - Complex tasks and decisions by Operator
    - Medium and simple tasks by computers





# Main challenges in telerobotics

- Telesurgery: an example of success!



# Main challenges in telerobotics

- Teleoperated system for live-line maintenance

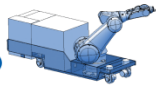


# Puresafe main challenges in telerobotics

- Telerobotic Puresafe challenge is to improve technologies in “Emitting ionizing radiation infrastructures” (GSI and CERN) in order to:
  - Increase operator dexterity,
  - Improve operator remote environment perception, and
  - Reduce the number of complex tasks (locomotion, procedures,...)

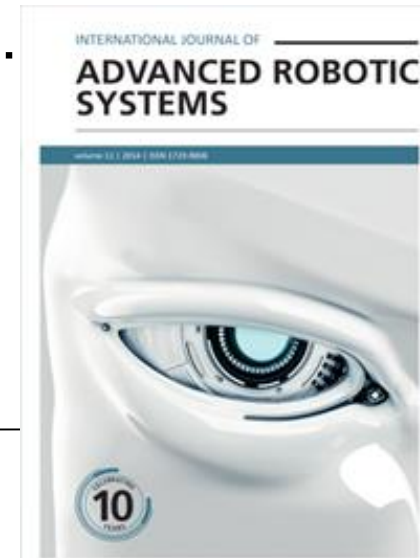






# Puresafe main challenges in telerobotics

- Puresafe actions:
  - Strong interaction among partners:
    - Seminars at TUT, KIT and UPM about technologies
    - Courses at CERN and GSI focus on maintenance under radiation
  - ESR rotation among partners
  - Conferences and dissemination activities of consortium: OpenSE, inTech SI,...

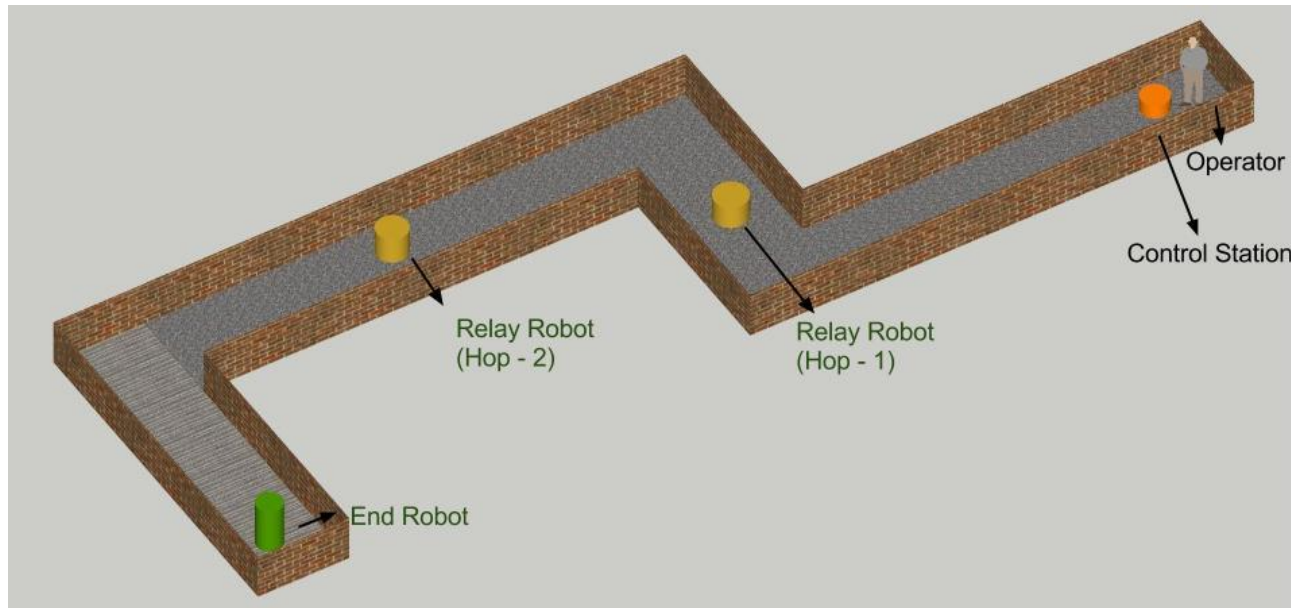


- **WP2: Remote Handling hardware platforms**
  - RP6. Generic mobile platforms development for remote radiation survey and inspection (Ramviyas N. Parasuraman, CERN)
  - RP7. Remote Handling concept study for the Super-FRS plug system (Luis M. Orona, GSI)
  - RP8. Design and evaluation of reconfigurable modular robot systems for execution of maintenance tasks (Prithvi S. Pagala, UPM)
  - RP9. Study of a logistic concept for Super-FRS RH components (Faraz Amjad, GSI)



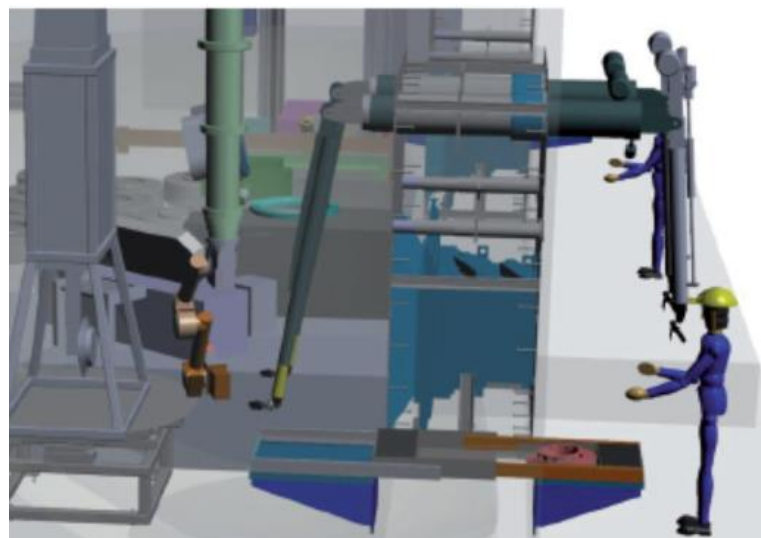
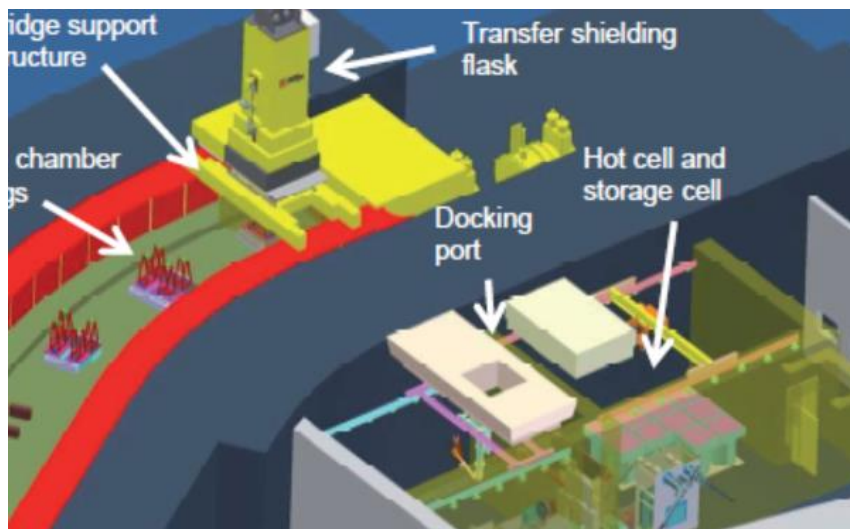
# Puresafe WP2 results

- Study of a wireless network by using mobile platforms



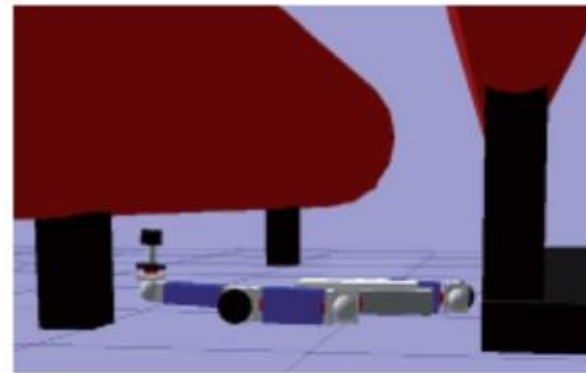
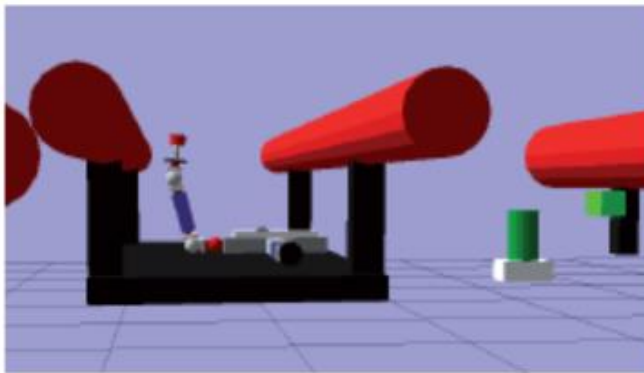
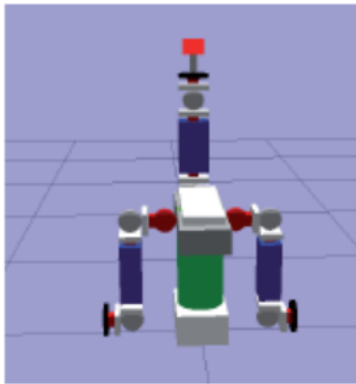
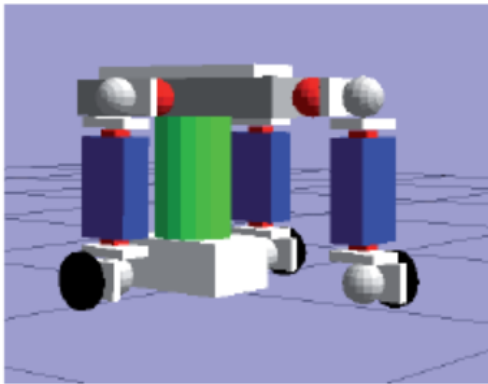
# Puresafe WP2 results

- Detail analysis of telemanipulation procedures in order to perform more efficient RH tasks at GSI



# Puresafe WP2 results

- Simulations about application of modular robots in complex environments





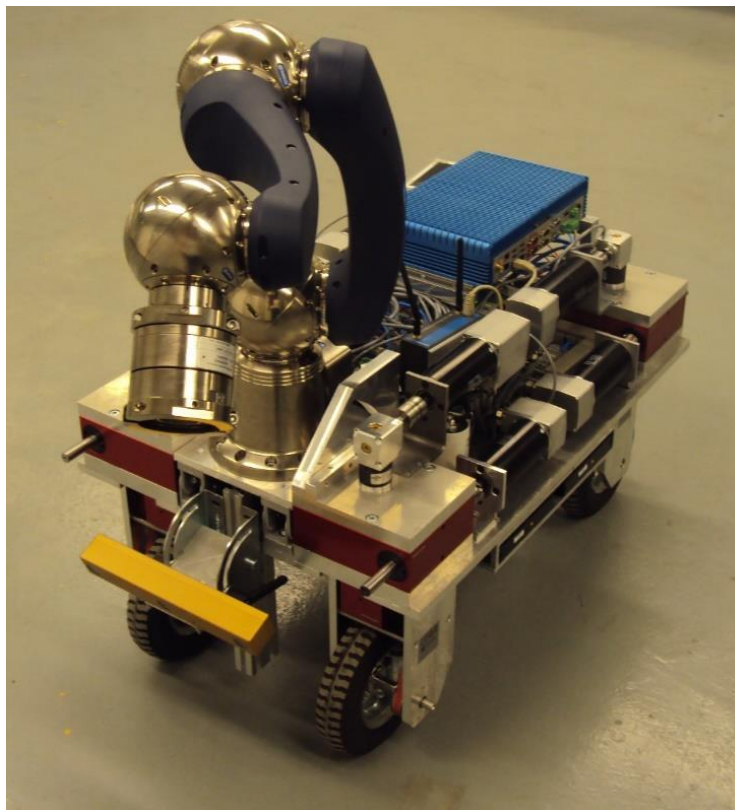
# Puresafe WP3 activities

- **WP3: Remote Handling software platforms**
  - RP10. Fault-tolerant Remote Handling control systems (M Mohammad Aref, TUT)
  - RP11. Augmented reality –based maintenance tool for hazardous places (Héctor Martínez, Sensetrix)
  - RP12. Interconnection of multi-robot and multi-user systems for cooperative tasks (Alexander Owen-Hill, UPM)
  - RP13. Augmented reality and data fusion for 3D radiation mapping (Thomas Fabry, CERN)
  - RP14. Assisting autonomous functionalities for safe tele-operation (Reza Oftadeh, TUT)
  - RP15. Human-Machine Interaction for Cooperative Remote and Manual Maintenance for Accelerator Projects (Enrique del Sol, OTL)



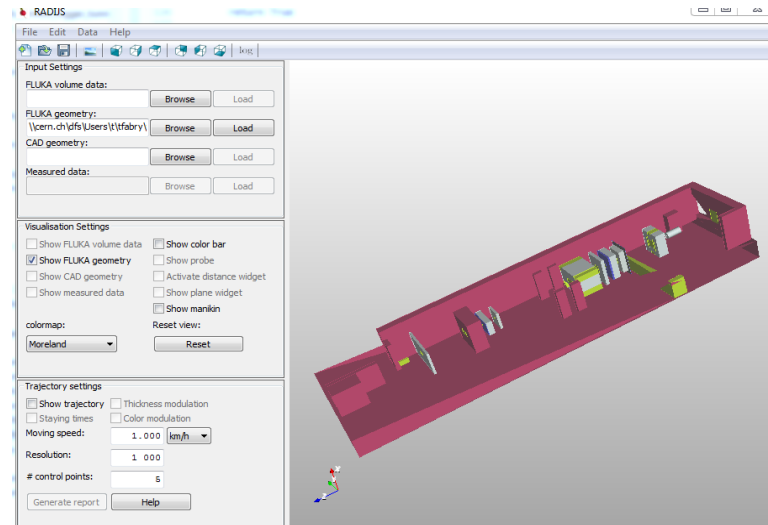
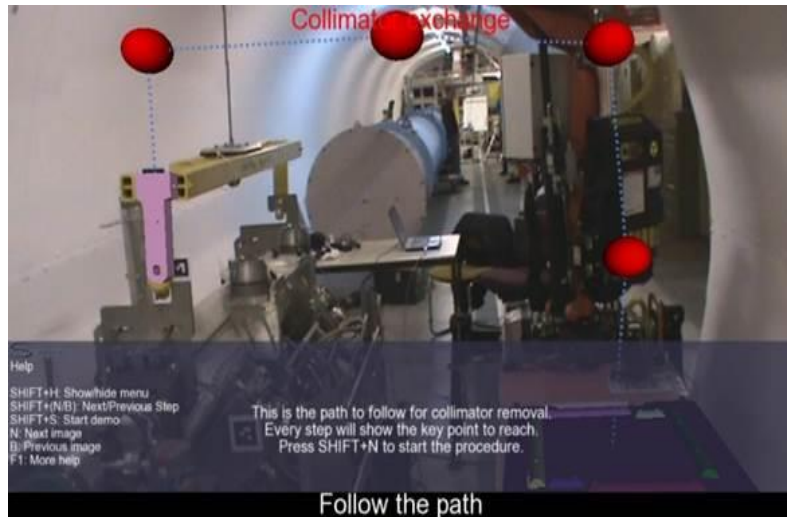
# Puresafe WP3 results

- TUT mobile and manipulator platform with 2 DoF per wheel



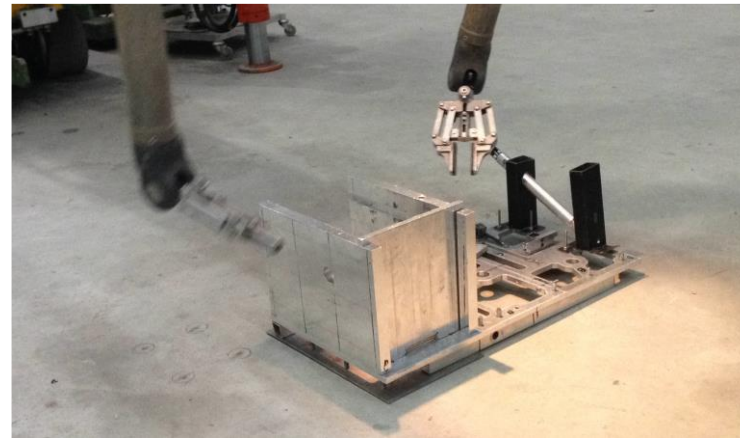
# Puresafe WP3 results

- AR and VR applications for ‘adding information’ during inspections under radiation



# Puresafe WP3 results

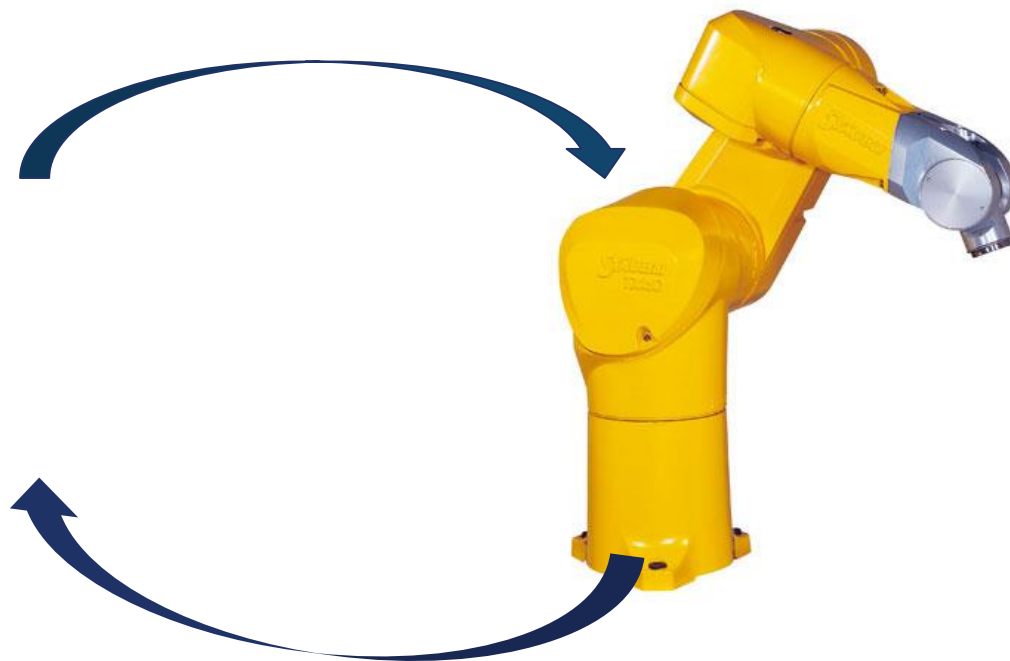
- Testbed for telemanipulation by using Mantis at CERN





# Puresafe WP3 results

- Bilateral controllers for improving force feedback perception





# Discussion

- No standard tools were defined at the beginning since the interest was to compare tools and platforms
- Open software:
  - ROS with Gazebo, C++ and Python
  - PostgreSQL, PostGIS, OpenRAVE and OpenAR
- Proprietary software
  - LabView, and MatLab
  - V-REP, CATIA
  - Fluka



# Summary

- Main challenges are related to locomotion, manipulation dexterity (operator perception).
- Productivity of telerobotics can be improved by developing specific tools/devices focused on the corresponding telemanipulation tasks
  - Technological constraints are reduced every year,
  - BUT more advances are required on reliability and procedure simplification
- Open hardware (Arduino, ...) and software (ROS, Gazebo,...) tools are suitable for developments with a medium or low degree of complexity.



Thank you to all ERS  
and supervisors for  
their contributions !!

