IST has been working in ITER Remote Handling related projects since 1996. The involved teams have expertise and are willing to continue working in these challenging areas in ITER and DEMO.

Expertise and Skills in Remote Handling

- **Motion planning** for mobile platforms, i.e., the CPRHS (Cask and Plug Remote Handling System) and CTS (Cask Transfer System) based on line guidance or free roaming, including maneuvers and maximization of common parts of different paths.
- **Remote navigation and guidance** methodologies of mobile platforms with different kinematics.
- Obstacle detection and avoidance.
- On-board and off-board sensor **specifications**, in particular laser range scanners (LIDAR systems), inertial systems and video cameras.
- **Sensor systems**, **data acquisition**, **integration** and **processing**.
- Viewing systems to support navigation and control.
- **Signal processing** for environmental perception.
- **Localization approaches** based on different in-board and off-board sensors.
- Control systems for remote operations.
- **Feasibility analysis** of the Tokamak and Hot Cell buildings of ITER, including the doors profiles (dimensions, aperture angle and direction).
- **Logistics analysis and operational planning** with different cask typologies.
- 3D **Virtual Reality** (VR) models and **Augmented Reality** (AR).
- Development of **standalone software** applications for evaluation and simulation of motion planning and guidance.
- Experience on programming (e.g., MATLAB, C/C++).
- Experience on CAD software and Finite Elements Analysis (e.g., CATIA and ANSYS).
- **Design of a Multi-Purpose Rescue Vehicle** for unexpected situations, such as rescue and recovery operations.
- **Rescue and recovery operations**.
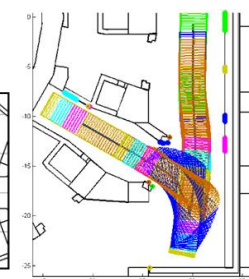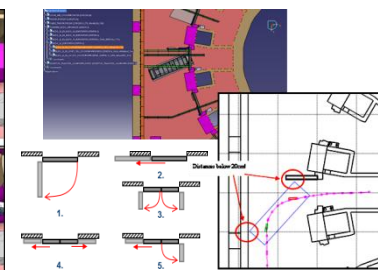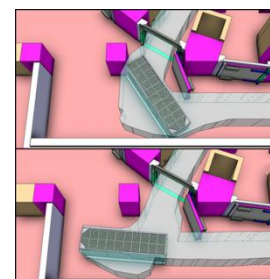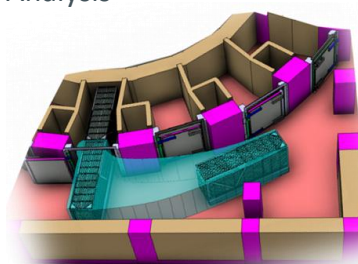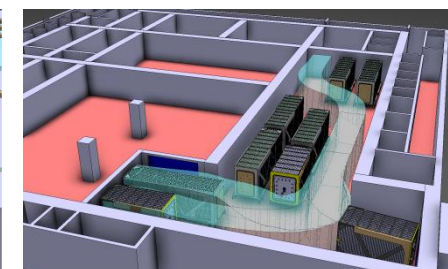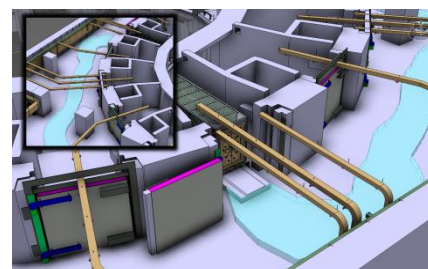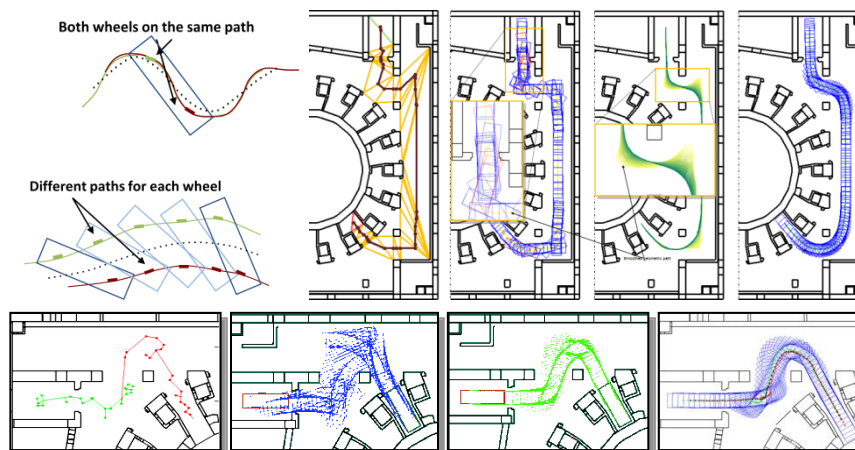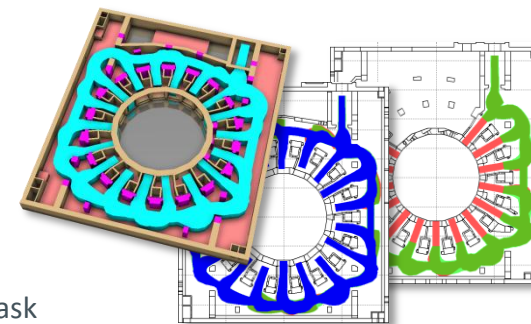
- **Redundancy systems** design with adapted behavior under failure.
- **Design of test facilities** for experimentation and training operators, reproducing expected and unexpected situations of the real scenarios.
- Feasibility analysis of the Active Maintenance Facility of **DEMO**.
- **Prototyping of a trolley** to transport heavy components along the Active Maintenance Facility of **DEMO**.
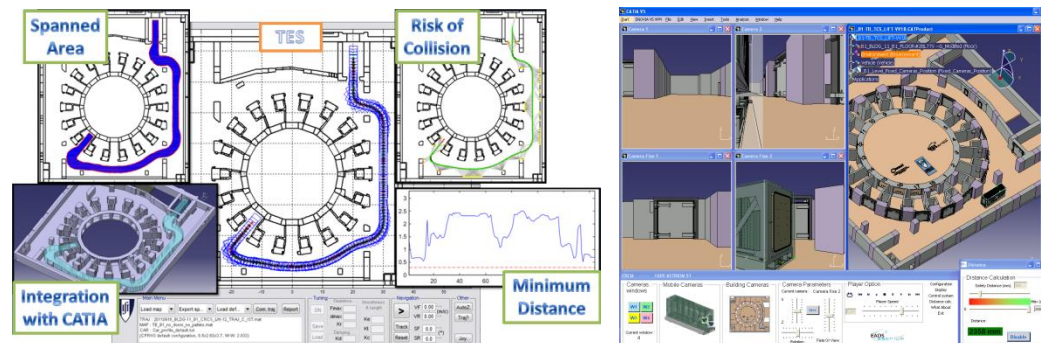
Previous Remote Handling projects

- **3 grants EFDA** (conceptual study on flexible guidance and docking system and geometry feasibility for the transfer casks in ITER).
- **2 grants F4E** (activities related to the development of the cask transfer system, trajectory optimization and feasibility analysis of ITER main buildings).
- **1 contract with EUROFUSION** under the Remote Maintenance Work Package (design concept and perform prototype testing of ex-vessel transfer casks, cranes and servo manipulators in **DEMO**).
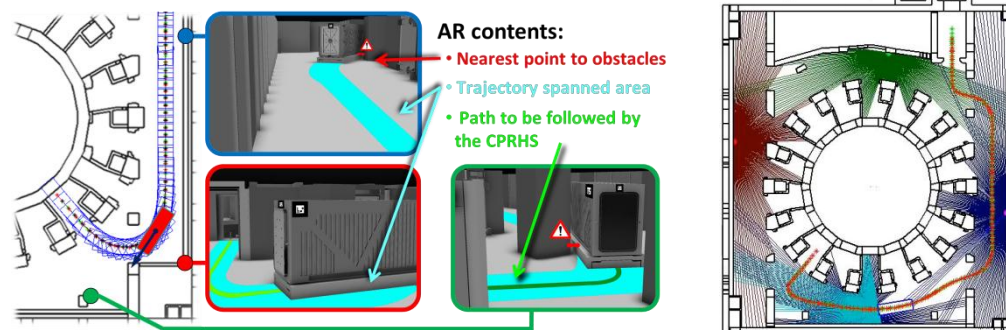
Educational and professional qualifications

- **2 senior engineers** on robotics and control.
- **1 senior engineer** on physics and nuclear fusion.
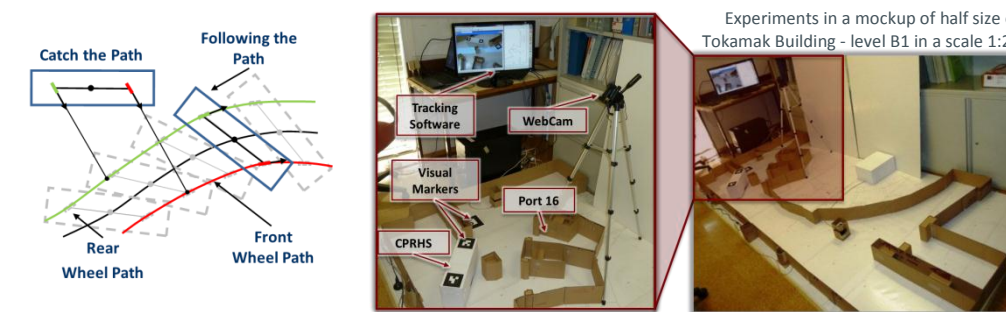- **2 engineers** on programming and CAD software.

Project management

- **1 senior project manager** according to all requirements of QA of F4E.
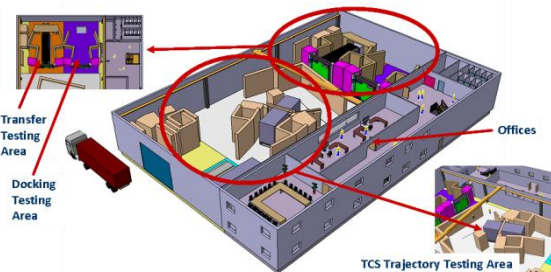
Publications on Remote Handling

- More than 25 publications (last 5 years), master thesis and awards.

Instituto Superior Técnico
Av. Rovisco Pais 1
1049-001 Lisboa, Portugal
Phone/Fax: (+351) 218419098/218417819
e-mail: avale@ipfn.tecnico.ulisboa.pt
URL: http://www.ipfn.ist.utl.pt/rh/

Experiments in a mockup of half size of Tokamak Building - level B1 in a scale 1:25

Design of a test facility

Design of a Multi-Purpose Rescue Vehicle