

MECHANICAL ENGINEERING

DIMEAS - Numerical modelling of remote handling systems

Funded By	CONSORZIO PER L'ATTUAZIONE DEL PROGETTO DIVERTOR TOKAMAK TEST DTT S.C. A R.L. [Piva/CF:15408721007] Dipartimento DIMEAS
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Context of the research activity	The research deals with the numerical modeling of remote handling systems designed for maintenance operation in a TOKAMAK reactor for nuclear fusion plants. The models will be developed with different levels of fidelity in order to be used first in the design phase, than in the development of precise control algorithms and eventually in a real time simulation environment
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Objectives	<p>The proposed activity is aimed at the study of remote maintenance systems through the development of their numerical models. In particular, it intends to concentrate activities on the development of high-fidelity dynamic models of systems under development, in order to provide support in the design phase and in the creation of a digital twin that can be used for the development of control and coordination with other subsystems.</p> <p>The model of robotic systems will have to take into account their elasticity and compliance.</p> <p>It is also envisaged to use the developed models also for the development of methodologies and algorithms to help in the use of the devices, with particular attention to algorithms for the automatic compensation of the elastic deformations of the arms, and to collision avoidance algorithms extended to the complete structure of the robots that allow to automatically correct the set trajectories, avoiding impacts with the structures, with other robots used and with the parts in the handling phase</p> <p>Development plan:</p> <p>Year 1) analysis of the architecture of the robots/robotic arms under development. Realization of dynamic models with lumped parameters in rigid bodies and elastic bodies. Analysis of existing control algorithms and development of any supplementary modules, with particular attention to the management of redundant kinematic architectures. Setting of algorithms for the automatic correction of trajectories in order to avoid collisions</p> <p>Year 2) completion of the elastic deformation correction algorithms. Setting up collision avoidance algorithms between robotic arms and with the infrastructure. Analysis of usable sensors. Study of possible hardware architectures for detecting the real position of the arms</p> <p>Year 3) completion of the development of collision avoidance algorithms and integration with those for the correction of elastic deformations. Integration in a virtual environment of reproduction of a portion of the Tokamak</p>
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Skills and competencies for the development of the activity

Use of mechanical simulation software: Matlab/Simulink/Simscape, ADAMS, Gazebo. Use of ROS. Analytical modeling of robotic systems. Control of robotic systems