OPTIMIZED TRAJECTORIES OF THE TRANSFER CASK SYSTEM IN ITER

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The Transfer Cask System (TCS) is a partially shielded vehicle unit (with respect to gamma radiation), to perform Remote Handling (RH) operations, transporting heavy (20~80T) and highly activated in-vessel components between the Tokamak Building (TB) and the Hot Cell Building (HCB). The TCS uses air-cushion technology and moves autonomously or semi-autonomously, between TB and HCB, along optimized trajectories, in highly confined spaces and under demanding safety requirements of transportation.

A motion planning methodology was developed at IST, yielding smooth trajectories that maximize the clearance to the closest obstacles [1], and that incorporates maneuvers whenever necessary. The optimization criterion is constrained by the highly confined spaces, maximizing the clearance to the closest obstacles. Maneuvers arise frequently as the only solution to safely solve the space confinement.

This paper presents the main results obtained with the referred motion planning algorithm in all levels of TB and HCB where the TCS operates. A total of 65 trajectories were evaluated, 46 trajectories in TB and 19 trajectories in HCB, which include nominal operations, maneuvers and parking. Figure 1-left illustrates the area spanned by the TCS along all the optimal trajectories in level L1 of TB (the doors of all Vacuum Vessel port cells are hidden for simplicity in visualization). The maneuver to enter in port cell 8 is highlighted in Figure 1-center. Parking maneuvers in level L3 of HCB are illustrated in Figure 1-right. The time duration, the travelled distance, the velocity and acceleration, the risk of collision (evaluated as the minimum distance to the closest obstacle), and the risk of slippage were evaluated individually for each trajectory in all levels.

Conclusions and open issues are presented and discussed in this paper.

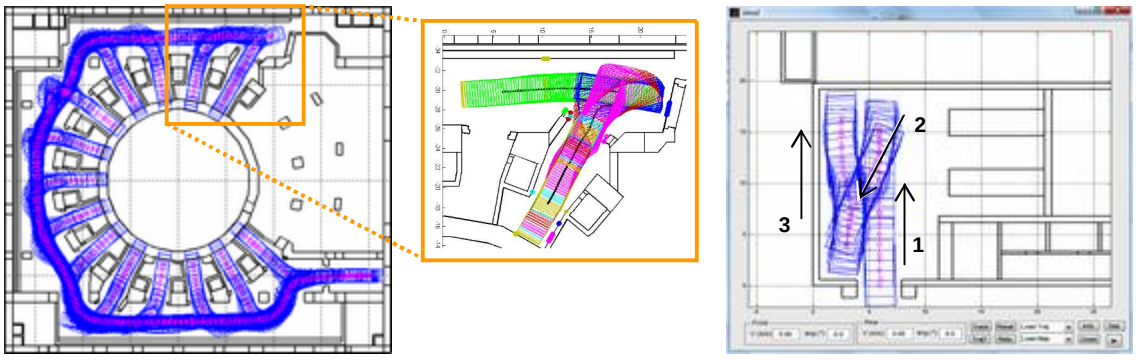

Figure 1 – (left) the 14 optimized trajectories in level L1 of TB; (center) maneuver in the entrance of Vacuum Vessel port cell number 8; (right) parking maneuver in level L3 of HCB.

References:

[1] A. Vale, D. Fonte, F. Valente, I. Ribeiro. "A Motion Planning Methodology for Rhombic-like Vehicles for ITER Remote Handling Operations". Proceedings of the IAV 2010- 7th IFAC Symposium on Intelligent Autonomous Vehicles, Lecce, Italy, 2010.