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THESIS ABSTRACT:

FORMULATION AND STUDY OF CONTROL PROBLEMS IN ROBOTICS CO-MANIPULATION

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In this thesis, we address the co-manipulation control problems for the handling tasks through a viewpoint that we do not think sufficiently explored, even it employs classical tools of robotics. The problem of robotic co-manipulation is often addressed using impedance control based methods where we seek to establish a mathematical relation between the velocity of the human-robot interaction point and the force applied by the human operator at this point.

This thesis addresses the problem of co-manipulation for handling tasks seen as a constrained optimal control problem. The proposed point of view relies on the implementation of a specific online trajectory generator (OTG) associated to a kinematic feedback loop. This OTG is designed so as to translate the human operator intentions to ideal trajectories that the robot must follow. It works as an automaton with two states of motion whose transitions are controlled by comparing the magnitude of the force to an adjustable threshold, in order to enable the operator to keep authority over the robot's states of motion. To ensure the smoothness of the interaction, we propose to generate a velocity profile collinear to the force applied at the interaction point. The feedback control

loop is then used to satisfy the requirements of stability and of trajectory tracking to guarantee assistance and operator security. Several methods are used to design efficient controllers that ensure the tracking of the generated trajectory. The overall strategy is illustrated through two mechanical systems. The first is the penducobot which is an underactuated robot. The second is the planar robot with two degrees of freedom fully actuated.