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Trajectory Tracking of Coordinated Multi-Robot Systems using Nonlinear Model Predictive Control

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Abstract: This paper proposes a centralized and decentralized nonlinear model predictive control (NMPC) for multiple robots in the trajectory tracking problem with collision avoidance. The kinematic model of mobile robot is employed to implement these concepts. The path of each robot is constructed such that there exist some intersections between some paths of the robots. Additionally, the initial conditions and parameters of the model are taken so that the robots will collide on the intersections of their paths. Based on the simulation results, both centralized and decentralized schemes can avoid collision between one robot and another one by satisfying the inequality constraints. All solutions of the optimization problems in both schemes are feasible as well, so this indicates that local minimum solutions are found. According to the simulations, the decentralized scheme is better than the centralized scheme in terms of the computational complexity and error tracking.

Keywords: *nonlinear optimization; multiple robots dynamics; nonlinear model predictive control; centralized and decentralized schemes.*

Mathematics Subject Classification (2010): 65K10, 70E60, 90B15, 49M37.

1 Introduction

During the last years, the research interests in robotics area have grown exponentially from some publications (refer to [1–3]), but are not limited to those. Nowadays, to employ a robot for many kinds of tasks is very common in various fields such as agriculture, logistics, and even service for some of Covid-19 patients in hospital [4–6]. In those applications, it is expected that the robot can be navigated in different situations and environments [7]. The strategy can be done by controlling its position, so that it can

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