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MOBILE ROBOT LOCAL TRAJECTORY TRACKING WITH DYNAMIC MODEL PREDICTIVE CONTROL TECHNIQUES

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Abstract. *This paper extends the authors' previously published work for mobile robots to trajectory tracking with dynamic model-based predictive control techniques. The use of dynamic models and experimental cost-function factor adjustments are important aspects of this work. A set of dynamic models obtained from experimental robot system identification is used to predict the population of available coordinates. The use of contractive constraints guarantees the convergence of the robot coordinates towards the desired ones. Local trajectory planning is another relevant aspect of this work. Using this approach, when dynamic environments or obstacle-avoidance policies are considered, navigational path planning should be constrained to the robot neighborhood. Testing and analysis of experimental results for trajectory tracking are reported in this paper. In this context, the performance of various parameter weights in the cost function is studied. Factor tuning is tested using various kinds of trajectories. The experiments performed show that control laws as a flexible cost function of the path to be tracked can improve system performance.*
Keywords: Mobile robots, Dynamic model-based predictive control, Contractive local-trajectory tracking, Factorial cost-function tuning

1. **Introduction.** Biological systems are being successfully used as reference model sources by robotic researchers. As a result, walking humanoid systems, for example, seem to have advanced. They can now overcome small obstacles as well as move up and down stairs. The locomotion advantages of walking robots with respect to WMRs (wheeled mobile robots) are clear. However, WMR has some advantages with regard to speed, price and power consumption. Robot behavior is still simple compared to human behavior. Future approaches to achieving further progress will involve the integration of several fields of knowledge to perform a higher level of reasoning using decision tools with a strong theoretical basis [1].

This paper presents control techniques based on MPC (model predictive control) applied to differentially driven WMRs. Other important aspects, such as local on-robot perception and navigation issues, are considered as important constraints to accomplish the various missions. The use of robot models is an important issue that subsumes path-tracking control within a broad perspective, including aspects such as perception measurements [2]. For instance, Matsuo [2] has proposed model-based velocity estimators as efficient and robust observers that reduce noise measurement problems.

The control strategies used for WMRs should obey safety rules as well as achieving the final desired configuration. The scientific community has carried out a number of studies in this field. The dynamic window approach is based on the dynamic constraints of the WMR and uses the available robot speeds to plan avoidance of collisions with obstacles, safety stops and achievement of goals [3]. Rimon [4] presented methodologies for exact