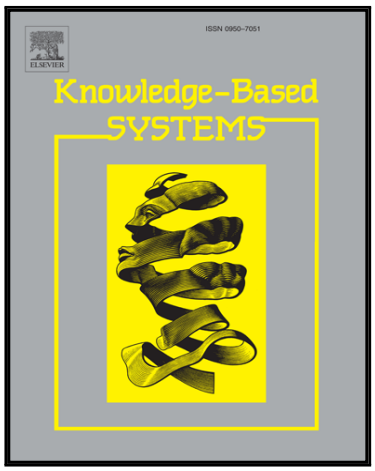

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Spatio-temporal decomposition: a knowledge-based initialization strategy for parallel parking motion optimization

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Abstract

Motion planning methodologies for parallel parking have been well developed in the last decade. In contrast to the previous works that proposed the prevailing and emerging parking motion planners, this work provides a precise and objective description of the parking scenario and vehicle kinematics/dynamics. This is achieved by formulating a unified optimal control problem that is free of any subjective knowledge (e.g., human experiences). Such an objective knowledge based system contributes in breaking the limitation of subjective knowledge and fully utilizing a vehicle's potential. The concerned optimal control problem, when numerically converted into a large-scale nonlinear programming (NLP) problem, is extremely difficult to solve. This bottleneck has hindered many previous research efforts. Although the search domains of NLP problems are clearly defined, the majority of NLP-solving processes still require high-quality initial guesses, which accelerate the convergence process. In this work, a spatio-temporal decomposition based initialization strategy is proposed to generate reliable initial guesses and to facilitate the NLP-solving process. A series of comparative simulations verifies that the proposed initialization strategy is advantageous over its prevailing competitors, and that the proposed motion planner is promising for on-line planning missions. Theoretical analysis that supports the proposed initialization strategy is provided as well.