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Hierarchical Tracking Control of Wheeled Mobile Robot

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For a mobile robot or a vehicle moving with rolling-without-sliding wheels, nonholonomic constraints need to be dealt with in order to design an effective controller. Based on Jourdain's variational equation and Appell's approach, it is possible to formulate the dynamics of the vehicle in terms of the privileged coordinates which satisfy the reduced Appell's equations. If this set of equations is decoupled from the other non-privileged coordinates, we may design a controller to track the privileged coordinates of the given desired trajectory. On the other hand, to track the non-privileged coordinates, the kinematic conditions of constraints are re-structured from which the compensations for the desired values of privileged coordinates are computed. The updated reference values for the privileged coordinates are then fed into the controller for the reduced Appell's equations. The proposed hierarchical tracking control thus treats the dynamical equations and the kinematic equations at different stages. From the simulation results, it is shown that such hierarchical tracking control strategy indeed gives rise to an effective algorithm for dealing with tracking problem.

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