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A Novel Approach of Estimating the Kinematics for a Manta Ray Inspired Swimming Mobile Robot

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Abstract:

This paper presents a novel approach of deriving and estimating the kinematic model of the generic configuration of a swimming mobile robot inspired by manta ray. Initially, the conventional method of mathematical model of linear and angular velocities are described, considering the kinematic model of the traverse entity on a 2-D plane. These parameters are novelly derived to represent a higher degree of motion on a complex environment. Due to the complexity of the environment, the flight dynamic stability analysis is implemented in the derivation, however, the unwanted portion is eliminated from the equation. As a result, the estimated kinematic model is characterised providing the natural performance in mobile robot applications particularly in ocean exploration. Meanwhile, the overarching concept of the proposed system is implementing the layered-architecture mobile robot control whereby the highest level control layer defines the overall perception of the environment condition. The model of the swimming trajectory within this layer and construction is using the multivariate Gaussian function. Further, the pre-planned path is projected onto the trajectory model providing a complete higher degree of freedom mobile robot kinematic equation. Simulation results are also presented which demonstrate the good performance of the proposed model under randomly generated ocean and seabed conditions.