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MODIFICATION OF THE INVERSE DYNAMICS ALGORITHM FOR AN UNDERWATER MULTILINK MANIPULATOR

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The paper addresses the problem of improving the accuracy of a recursive algorithm for solving the inverse dynamics of underwater multi-link manipulators—essential components of unmanned underwater vehicles (UUVs) designed for technological operations. In contrast to existing approaches, the proposed modification explicitly accounts for the dependence of viscous drag forces on the actual incoming flow velocity, which is determined by the manipulator's instantaneous configuration: the relative positioning of its links causes certain segments to reside within the wake generated by upstream links. To characterize this effect, virtual flow simulations of an isolated manipulator link in an undisturbed fluid stream at varying velocities were carried out using SOLIDWORKS Flow Simulation. The resulting data were employed to compute the actual local flow velocities acting on link segments located in the wake region. The modified algorithm was implemented and numerically simulated in MATLAB/Simulink using a model of a multi-link manipulator mounted on an unmanned underwater vehicle. The simulation results demonstrate the effectiveness of the proposed approach in enhancing the accuracy of dynamic load estimation due to viscous fluid interaction—particularly under ambient underwater currents.

Keywords: underwater multilink manipulator, inverse dynamics problem, viscous fluid, wake, incoming flow, manipulation tasks.

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