



# An Adaptive Approach for Precise Underwater Vehicle Control in Combined Robot-Diver Operations

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Joint robot-human operations potentially increase the efficiency, effectiveness and safety of the tasks they perform. The utilization of an autonomous underwater vehicle (AUV) as a robotic diver's assistant demands joint, dynamic operations involving precise physical interactions between an AUV, human divers, and the environment, which, in turn, requires a robust, accurate control system. A robot acting as a dive assistant would perform tasks such as tool carrying, worksite illumination, or other general assistance jobs that a "dive buddy" might perform. Such precise control of the AUV normally requires accurate knowledge of the vehicle's dynamics; however, this high level of accuracy is difficult to obtain without the employment of extensive system identification efforts. Additionally, the utility of the resulting model is greatly diminished if environmental conditions or vehicle configuration change frequently or unexpectedly. An ideal control system allows the AUV to switch between operational modes and objectives while accounting for uncertain environmental conditions, payload configurations, and possible failures of onboard actuators. Adaptive control has many applications in the underwater domain and can give a robotic diver's assistant the flexibility required to enable joint robot-diver operations. Therefore, two adaptive control system approaches, Model Reference Adaptive Control and L1 Adaptive Control, are investigated here for heave control of the Tethered, Hovering Autonomous Underwater System.



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