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MODELING, DESIGN AND EXPERIMENT OF IMPROVED SUPER-MINI UNDERWATER ROBOT

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Abstract. *To overcome the disadvantages appeared in the application of some super-mini underwater robots, a simple improved design framework is proposed. A mechanical improvement scheme is proposed. An easy handle, powerful and computer aided software system including the closed-loop control algorithm is developed for solving the shortcomings that are existed in the manual operation. The modeling of underwater robot plays an important role in the closed-loop control design. The hydrodynamic derivatives are estimated by the experiment based on the decoupled motions in different directions. A new self-tuning PID algorithm is proposed for the controller design. The experimental results in different environment demonstrate the performance.*
Keywords: Modeling, Autonomous control, Underwater, ROV, Self-tuning

1. **Introduction.** Until now, many underwater robots including remotely operated vehicle (ROV) and autonomous underwater vehicles (AUV) have been developed and applied for detection, salvage, mine hunting, fishery study, etc. More recently, there has been a trend to use the super-mini underwater robots in lakes and rivers. The implementation of AUV is complex as the individual intelligent platform. AUV is generally expensive and has not been popularly applied in the practical works. This paper mainly considers the improvement of ROV. For the low cost and easy manual operation, ROV draw the attention of many users. Recent results show that the super-mini underwater robots have significant potential to carry out the tasks such as the target reconnaissance, inspection, repair of underwater structures, etc.

However, due to the reply from the pilots, the shortcomings of some underwater robots come out in practical tasks, such as the steady station-keeping near the dyke or bridge piers. The drift, waves, etc always cause the troubles. The manual operation is often impossible to catch up the time-varying disturbance, as the microoperation is uneasy to handle by the pilots. In this paper, an improved design framework is proposed including two parts. One improvement is focused in mechanical design. The other improvement includes the underwater robot deployed with integrated, intelligent, close-loop control platform such as the implementation of the obstacles avoidance, the steady station-keeping, etc. This close-loop control is consisted of a new self-tuning PID controller. The pilots only need to give easy commands such as navigation, station-keeping or depth-keeping, etc. Meanwhile, this computer aided control platform requires proper dynamic models.