

# Optimization of the Hydrodynamic Performance of an In-Service AUV

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**Abstract:** The AUV, AUTOSUB, developed by the Ocean Engineering Department of the Southampton Oceanography Centre is a versatile vehicle for the collection of scientific data. It has been used successfully worldwide for a range of missions over recent years including two beneath the Antarctic ice-shelf. In parallel with its in-service programme there is ongoing research to monitor and improve its performance. In particular means to increase mission range and versatility are sought. This paper describes methods for improving the hydrodynamic performance of in-service AUV's.

The AUV propulsion system has been analysed and this has demonstrated that significant improvement to vehicle range should be possible by reduction of drag and increased propeller efficiency. In addition improving the control algorithms will enable more complex mission tracks to be undertaken.

As part of the programme for drag reduction a means of quantifying appendage resistance on practical in-service AUV's has been developed, together with the means to reduce it. To this end, towing tank experiments using a captive model of AUTOSUB to accurately determine the total drag, its components and sources have been carried out. Regions of excessive flow disturbance around

critical parts of the body are identified using flow visualisation. The results of these experiments are used to develop a means of predicting the effects of body attitude, control surface angle, and mission dependent appendages on vehicle performance. From this, algorithms are developed which enable optimum size, shape and position of mission dependent appendages to be determined. A simple trial is described which enables the efficacy of these algorithms to be verified. This trial provides an economic means of measuring the propulsion performance of the actual vehicle in-service.

To further reduce drag, different hull coatings could be applied. To this end, the effectiveness of compliant surfaces in reducing drag by delaying the transition from laminar to turbulent flow has been investigated.

To enable the development of improved control algorithms, a computer simulation has been developed. Estimates of the manoeuvring derivatives have been used to develop a three dimensional simulation of AUTOSUB. This is used to establish the effect of changes in control system algorithms to determine their effect on range and manoeuvrability. It is also being used in the development of mission planning and evaluation software.