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Hydrodynamics of an Under-actuated Plesiosaur-inspired robot. GABRIEL WEYMOUTH, KATE DEVEREUX, NICK COPSEY, LUKE MUSCUTT, JON DOWNES, BHARATH GANAPATHISUBRAMANI, University of Southampton — Underwater vehicles are increasingly important tools for use in science and engineering, but maneuverability and mission life seem to be mutually exclusive goals. Inspired by the unique swimming method of the plesiosaur, which used four flippers of essentially equal size and musculature, we analyzed designed and built an underwater vehicle with the potential for both gliding and active maneuvering modes. Using 2D simulations and strip theory approximation to account for the changing arc length along the flipper span, we studied the wake and forces on the foils and determined the optimum flipper geometry, spacing and kinematics. To reduce mechanical and control complexity and cost, we next studied the impact of under-actuated kinematics. Even after optimizing pivot location and range of motion, leaving the foils free to pitch was found to reduce efficiency by approximately 50%. Based on these specifications, the vehicle was built and tested over a range of free swimming and maneuvering cases using motion tracking equipment. The excellent maneuverability of the under-actuated vehicle validates the concept, and the new platform should enable further detailed experimental measurements in the future.

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