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A Cosserat-based formulation for elastic, axisymmetric shells with implications to the pulsed-jetting propulsion of soft-bodied aquatic vehicles FEDERICO RENDA, Khalifa University Robotics Institute, Khalifa University, FRANCESCO GIORGIO-SERCHI, Southampton Marine and Maritime Institute, University of Southampton, FREDERIC BOYER[1], Institut de Recherche en Communication et Cybernetique de Nantes, Ecole des Mines de Nantes — We take the cue from recent development in geometric-based modelling in order to describe the dynamics of a novel soft-structured aquatic vehicle. The Cosserat-like formulation for an axisymmetric, elastic shell subject to concentrated dynamic loadings lends itself to the case of this new vehicle, recently designed by the authors, which consists of a shell of rubber-like materials undergoing sequential stages of inflation and deflation in order to propel itself in water via pulsed-jetting. The experiments performed on the existing robotic prototypes are used for the validation of the geometric model. This is eventually employed for deriving an accurate measure of the efficiency of propulsion which explicitly accounts for the elastic energy involved during the propulsion routine. The model yields a-priori estimations of swimming efficiency based on vehicle specifications and mode of actuation. These provide invaluable information for both design optimization and control, as well as a means to study the biomechanics of soft-bodied aquatic organisms.

[1]Presenting author

Francesco Giorgio-Serchi
Southampton Marine and Maritime Institute, University of Southampton

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