2D µPIV Investigation of Artemia Salina Swimming Dynamics

Guilherme M. Bessa[*], Rafael Ayala Lara[*], and Matilda Backholm[*]

Swimming and swarming are fundamental processes in nature, essential to various biological phenomena[1], yet remain poorly understood at the mesoscale (Reynolds number, Re∼1). This regime poses unique challenges arising from the interplay of viscous and inertial forces, which not only complicates theoretical modelling but also underscores the need for experimental investigations[2]. To address this gap, we conducted a 2D micro-Particle Image Velocimetry (µPIV) study to investigate the swimming dynamics of Artemia Salina, which can be classified as a mesoscale swimmer during a specific phase of its life cycle. The experiments utilized a custom µPIV setup consisting of a inverted microscope (Eclipse Ti2, Nikon, Japan), a high-speed camera (Phantom T4040, Vision Research Inc., US) operating at 1500 frames per second, and a backlight source. *Artemia sp.* of approximately 0.7-0.8 mm in length were introduced into a circular vessel (100 mm diameter, 20 mm depth) containing brine solution, with 3-µm polystyrene particles (01-00-303 micromer®, micromod Partikeltechnologie GmbH; Germany) serving as flow tracers. Velocity vector fields were processed using the open-source software PIVlab[3], enabling detailed visualization of the flow generated by actively swimming organisms. Preliminary results (illustrated in Figure 1) highlight the effectiveness of the applied methodology in resolving velocity distributions around the shrimp. These findings validate the experimental approach and provide a foundation for comprehensive investigations into the flow structures and thrust-generation mechanisms employed by Artemia salina. A more detailed discussion of these mechanisms will be presented at the conference. This study seeks to contribute with our understanding of mesoscale swimming dynamics, offering insights into efficient locomotion strategies. The results also have potential applications in bio-inspired design, mesoscale robotics, and the modelling of swimming and swarming phenomena critical to marine ecosystems.

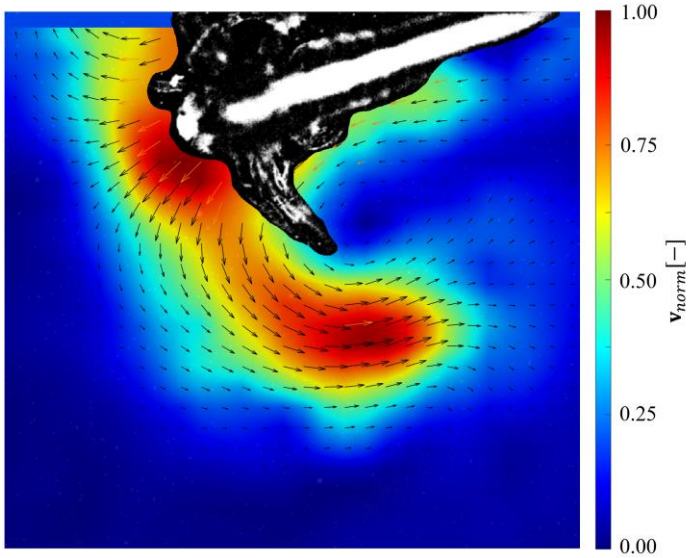

Figure 1: Velocity vector field around Artemia salina during the power stroke phase, with the arms positioned approximately orthogonal to the body. The organism is visible on the top side of the image. The velocity magnitude is depicted using a color-coded scale and is normalized relative to the maximum velocity.

[*] Department of Applied Physics, Aalto University, Espoo, Finland

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[3] Stamhuis, & Thielicke, *Journal of open research software*, **2**(1), 30 (2014).