Abstract Submitted
for the DFD08 Meeting of
The American Physical Society

Numerical simulation of a self-propelled copepod during escape[1]

FOTIS SOTIROPOULOS, IMAN BORAZJANI, St. Anthony Falls Laboratory, University of Minnesota, EDWIN MALKIEL, JOSEF KATZ, Johns Hopkins University — Obtaining the 3D flow field, forces, and power is essential for understanding the high accelerations of a copepod during the escap. We carry out numerical simulations to study a free swimming copepod using the sharp-interface immersed boundary, fluid-structure interaction (FSI) approach of Borazjani et al. (J Compu Phys, 2008, 227, p 7587-7620). We use our previous tethered copepod model with a realistic copepod-like body, including all the appendages with the appendages motion prescribed from high-resolution, cinematic dual digital holography. The simulations are performed in a frame of reference attached to the copepod whose velocity is calculated by considering the forces acting on the copepod. The self-propelled simulations are challenging due to the destabilizing effects of the large added mass resulting from the low copepod mass and fast acceleration during the escape. Strongly-coupled FSI with under-relaxation and the Aitken acceleration technique is used to obtain stable and robust FSI iterations. The computed results for the self-propelled model are analyzed and compared with our earlier results for the tethered model.

[1]This work was supported by NSF grant 0625976, NCED grant EAR-0120914, and the Minnesota supercomputing institute.

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Date submitted: 05 Aug 2008 Electronic form version 1.4