Computational Fluid Dynamics of Choanoagellate Filter-Feeding

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Computational Fluid Dynamics of Choanoflagellate Filter-Feeding SEYED SAEED ASADZADEH , Department of Mechanical Engineering, Technical University of Denmark, JENS WALTHER, Department of Mechanical Engineering, Technical University of Denmark and Swiss Federal Institute of Technology Zurich, Chair of Computational Science, LASSE TORE NIELSEN, THOMAS KIORBOE, National Institute of Aquatic Resources and Centre for Ocean Life, JULIA DOLGER, ANDERS ANDERSEN, Department of Physics and Centre for Ocean Life, Technical University of Denmark — Choanoflagellates are unicellular aquatic organisms with a single flagellum that drives a feeding current through a funnel-shaped collar filter on which bacteria-sized prey are caught. Using computational fluid dynamics (CFD) we model the beating flagellum and the complex filter flow of the choanoflagellate Diaphanoeca grandis. Our CFD simulations based on the current understanding of the morphology underestimate the experimentally observed clearance rate by more than an order of magnitude: The beating flagellum is simply unable to draw enough water through the fine filter. Our observations motivate us to suggest a radically different filtration mechanism that requires a flagellar vane (sheet), and addition of a wide vane in our CFD model allows us to correctly predict the observed clearance rate.

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