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The pressure is all in your head: A cilia-driven high-pressure pump in the head of a deep-sea animal JANNA NAWROTH, Emulate Inc., Boston, MA, KAKANI KATIJA, MBARI, Monterey, CA, MICHAEL SHELLEY, Simons Foundation, New York, NY, EVA KANSO, USC, Los Angeles, CA — Motile cilia are microscopic, hair-like structures on the cell surface that can sense and propel the extracellular fluid environment. In many ciliated systems found in nature, such as the mammalian airways and marine sponges, the organization and collective behavior of the cilia favors the pumping of fluids at low pressures and high volumes. We recently discovered an alternate design located in the head of a deep-sea animal called Larvacean. Here, cilia morphology, kinematics and flow indicate a role in maintaining the hydrostatic skeleton of the animal by generating a high-pressure flow. We describe our empirical and computational approaches toward understanding the design principles and dynamic range of this newly discovered pumping mechanism. In ongoing work, we further explore the fluid dynamic constraints on the morphological diversity of cilia and the resulting categories of fluid transport functions.

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