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Collective hydrodynamic communication through ultra-fast contractions SAAD BHAMLA, ARNOLD MATHIJSSEN, MANU PRAKASH, Stanford University — The biophysical relationships between physiological sensors and actuators were fundamental to the development of early life forms, as responding to external stimuli promptly is key to survival. We study an unusual protist *Spirostomum ambiguum*, a single-celled organism that can grow up to 4mm in size, visible to the naked eye, as a model system for impulsive systems. Coiling its cytoskeleton, this ciliate can contract its long body within milliseconds, one of the fastest accelerations known in cell biology. We demonstrate that these rapid contractions generate long-ranged vortex flows that can trigger other cells to contract, repeatedly, which collectively leads to an ultra-fast hydrodynamic signal transduction across a colony that moves hundreds of times faster than the swimming speed. By combining high-speed PIV experiments and analytical modelling we determine the critical rheosensitivity required to sustain these signal waves. Whereas the biological motive is not fully understood, contractions are known to release toxins from membrane-bound extrusomes, thus we hypothesize that synchronised discharges could facilitate the repulsion of large-scale predators cooperatively. Please also see our other talk "Rheosensing by impulsive cells at intermediate Reynolds numbers".

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