Abstract Submitted
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Swarming in viscous fluids: three-dimensional patterns in swimmer- and force-induced flows[1] YAO-LI CHUANG, MARIA R. D'ORSOGNA, Dept. of Mathematics, CSUN Dept. of Biomathematics, UCLA, TOM CHOU, Dept. of Biomathematics UCLA Dept. of Mathematics, UCLA — Mathematical models of self-propelled interacting particles have reproduced various fascinating "swarming" patterns observed in natural and artificial systems. The formulation of such models usually ignores the influence of the surrounding medium in which the particles swarm. Here we develop from first principles a three-dimensional theory of swarming particles in a viscous fluid environment and investigate how the hydrodynamic coupling among the particles may affect their collective behavior. Specifically, we examine the hydrodynamic coupling among self-propelled particles interacting through "social" or "mechanical" forces. We discover that new patterns arise as a consequence of different interactions and self-propulsion mechanisms. Examples include flocks with prolate or oblate shapes, intermittent mills, recirculating peloton-like structures, and jet-like fluid flows that kinetically destabilize mill-like structures. Our results reveal possible mechanisms for three-dimensional swarms to kinetically control their collective behaviors in fluids.

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