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Chemotaxis affects hydrodynamics in suspensions of micro-swimmers ENKELEIDA LUSHI, MICHAEL SHELLEY, Courant Institute, New York University — Microorganisms are known to respond to a dissolved chemical substance by moving preferentially away or toward its source. We study such chemotactic responses at the population level when micro-swimmers are hydrodynamically coupled. To do this we couple a recently developed kinetic model of motile suspension dynamics with a field equation for a chemical substance that diffuses and is advected by the large-scale fluid flows created by the micro-swimmers. We also allow this substance to be produced or consumed by the swimmers themselves. Two models of chemotactic response are considered. One is a simple model for an organism smoothly turning, while moving at constant speed, to align with a chemical gradient. The second is a previously developed model of the effect of modulated run-and-tumble dynamics by individual swimmers. We investigate the linear stability of nearly isotropic suspensions for both models by considering both Pusher micro-swimmers and Pullers. An instability due to chemotaxis is shown to occur in a band of perturbation wavelengths. Nonlinear dynamics are investigated using numerical simulation in two dimensions. We observe aggregation and possible concentration divergences in suspensions of Pullers and the formation of mixing flows in suspensions of Pushers. In the latter case we observe that chemotaxis slows and modifies the mixing dynamics of the system.

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