Simulating microswimmers in nematic fluids
13 July 2021

Artificial microswimmers have received much attention in recent years. By mimicking microbes which convert their surrounding energy into swimming motions, these particles could soon be exploited for many important applications. Yet before this can happen, researchers must develop methods to better control the trajectories of individual microswimmers in complex environments. In a new study published in EPJE, Shubhadeep Mandal at the Indian Institute of Technology Guwahati (India), and Marco Mazza at the Max Planck Institute for Dynamics and Self-Organisation in Göttingen (Germany) and Loughborough University (UK), show how this control could be achieved using exotic materials named 'nematic liquid crystals' (LCs)—whose viscosity and elasticity can vary depending on the direction of an applied force.

Mandal and Mazza studied this scenario using 'multiparticle collision dynamics' algorithms, which describe how the atomic structures of nematic LCs vary over time. Combined with simulations of spherical microswimmers, the algorithms allowed them to investigate how the direction-dependent viscosities and elasticities of nematic LCs can affect the speeds and orientations of spherical microswimmers. Previous studies showed that their motions are starkly different to those found in conventional fluids; with microswimmers following non-random trajectories to minimize their elastic energy. Mandal and Mazza now also show that a microswimmer's speed will vary depending on whether it pushes or pulls the surrounding fluid; and also becomes slower when it pushes with a stronger force. The duo now hope that their simulation techniques could be easily extended to model the dynamics of multiple microswimmers.


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