3d tracking of zebrafish: many-body interactions, effective temperature and fear

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A large group of animals can be interpreted in the context of active matter. While most attention has focussed on birds (and in particular, Starlings) [1] and midges [2], here we consider a system closer to colloids: fish operate in a liquid medium, with strong hydrodynamic interactions [3]. In an analogous way to the power of models based interactions to predict the behaviour of colloidal systems, agent-based models may be able to capture certain collective behaviour in living systems.

While colloidal systems can exhibit strong many-body effects [3], where the effective interactions show a strong dependence on the density of the system, here we show that these effects are very strong in the social interactions which lead to the collective behaviour of zebrafish, with implications for the development of agent-based models. The system moreover exhibits time-dependence as the fish become accustomed to their environment. Structural analysis suggests that the time-evolution may be related to an effective temperature, which scales inversely with perceived danger.

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