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Modelling collective motion in animal groups

Abstract

Flocks of birds and schools of fish are a common sight. They come in all shapes and sizes and exhibit a variety of dynamical behaviours at the group level. For decades, researchers have worked on isolating sets of biologically plausible local interaction rules, such that if each member of a group follow these rules, the resulting structure and behaviour of the group as a whole will be similar to that observed in real flocks, schools, and other moving animal groups. These local interaction rules are often of the type 'stay close to your neighbours (attraction), but avoid getting close enough for collisions to occur (repulsion), and take the average heading of your neighbours (orientation)'. Mathematical, and/or computational, methods are typically employed to determine the group level properties that will emerge from a given set of local interaction rules.

In this talk I will provide an introduction to collective motion in animal groups, with an emphasis on mathematical/computational modelling approaches used in the field. In particular, the use of so called self-propelled particle models. Using work on the topic that I have been involved in from 2010 up to now as a backbone I aim to illustrate the utility of, and problematic issues with, the self-propelled particle model approach to collective motion in animal groups as it stands today.