Contribution ID: **223** Type: **Oral Presentation**

Identifying differences in the rules of interaction between individuals in moving animal groups

Wednesday, 11 July 2018 11:30 (20 minutes)

The spectacular patterns of collective animal movement have been, and remain, a long standing and major interest in many branches of science, including biology, mathematics, physics and computational science. It is thought that the emergent patterns of coordinated motion are the consequence of individuals applying simple rules to adjust their velocity based on the relative locations and movements of nearby group members.

From the early 1980s onwards, the dominant methods for examining hypotheses about simple rules of interaction leading to coordinated, and sometimes complex, group motion have been discrete time self-propelled particle models. Common to many of these models are interaction rules chosen such that individuals will adjust their velocity to: avoid collisions with nearby neighbours, align their direction of motion with group members located at intermediate relative distances, and move towards other group members that are at relatively greater distances.

In the last decade advances in automated visual and GPS tracking methods have led to the exciting development of techniques for estimating the local rules of interaction used by real animals to coordinate collective motion directly from observational data. Analysis of tracking data, particularly of birds or fish in motion, suggests that the form of interaction rules chosen in self-propelled particle models is indeed plausible, with real animals adjusting their velocities consistent with collision avoidance at short range, matching directions of motion, and attraction to distant group mates. However, the mechanics of real interactions differ in detail to those adopted in models, even if the broad principles appear the same.

In this talk I will discuss an averaging technique for estimating how individual's adjust their velocity as a function of the relative coordinates of their partners, and potentially other independent variables, directly from tracking data. Such techniques were first developed in concurrent studies by Katz *et al.* [1] and Herbert-Read *et al.* [2], and have since been further refined (see for example, [3]). I will then present some results that illustrate some of the commonalities and differences seen in the rules of interaction of different species of shoaling fish. I will discuss how randomisation methods can be used to identify when there are statistical differences in observed interaction rules of individuals belonging to different categories (for example hungry animals versus those that have recently fed to satiation). Finally, I will use these methods to examine differences in interaction rules between pairs of fish where one fish dominates leadership positions, and the other follows.

[1] Katz *et al. PNAS*, 108:18720-18725, (2011)
[2] Herbert-Read *et al. PNAS*, 108:18726-18731, (2011)
[3] Schaerf *et al.*, *Science Advances*, 3:e1603201, (2017)

Primary author: Dr SCHAERF, Timothy (School of Science and Technology, University of New England)

Co-authors: Dr HERBERT-READ, James (Department of Zoology, Stockholm University); Dr HANSEN, Matthew (Fange Lab, WFCB, UC Davis); DAVIS, Scarlet (School of Life and Environmental Sciences, University of Sydney); MYERSCOUGH, Mary (University of Sydney); Prof. SUMPTER, David (Uppsala University); Prof. WARD, Ashley (School of Life and Environmental Sciences, University of Sydney)

Presenter: Dr SCHAERF, Timothy (School of Science and Technology, University of New England)

Session Classification: Animal interactions & epidemiology

Track Classification: Zoology