Title : Numerical and experimental study of phase transitions in fish collective motion.

Fish collective motion is a research subject that interests biologists, physicists but also mathematicians, as it is the study of how local interactions lead to a global organisation of living systems.
We study fish collective motion experimentally, by filming them in a shallow water tank, and extracting their trajectories from the data. We are trying to understand the phase transitions in the global organisation of fish between a disordered state (swarming), all fish moving aligned with each other (polarization) or arranged in a circular motion (milling).
Phase transitions between those different states were shown to occur by changing solely the illuminance of the tank [1]. This led us to focus our research on fish's vision, and how perturbing this sensorial mechanism induces a change in local interactions and hence global organisation of the school of fish.
Since it is hard to study and quantify these sensorial mechanisms in experiments, we implement a mathematical model numerically to run simulations. We create a dialogue between our experiments and our simulations, so that we can parametrize our model and make it more biologically accurate. We quantify in our model the fish's vision with a radius and angle of vision, and are able to reproduce the experimental results seen in [1] by dynamically changing the radius of vision of every fish in our simulations. This could potentially help us better understand how fish's vision works, and help us understand the phase transitions in fish collective motion.

[1] : Lafoux, B., Moscatelli, J., Godoy-Diana, R. *et al.* Illuminance-tuned collective motion in fish. *Commun Biol* **6**, 585 (2023). https://doi.org/10.1038/s42003-023-04861-8