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School fish behaviour

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Fish schools present many similarities with physical systems. Composed by a large number of interacting entities, their global behaviour is dependent of key-parameters to be determined (number of fish, species,...). Theoretically, some models of self-propelled particles (SPP) have been recently proposed [1, 2] in order to describe the schools. Each particle follows the same set of rules and controls its movement on the state of its neighborhood. Complex collective features and a phase transition as a function of the particle density have been found in these SPP models.

We propose a new numerical model, based on the one by Vicsek *et.al.* [1]. We also found a phase transition and the qualitative behaviour of our numerical "school" shows realistic features, such as shoaling.

Experimentally, we developed a two-dimensional set-up and implemented a fish-tracking algorithm in order to improve the actual post- treatment analysis [3]. The fish motions are analyzed and the shape of the school is studied. We used the same analysis process in order to compare our simulations with our experiments. Our results are summarized into a few chosen characteristic parameters, such as the mean distance to the first neighbour or the mean school orientation.

The transition found in experimental data will be presented and the corresponding parameters in the model will be commented. The importance of the fish density and also of the environment (*e.g.* the shape of the container) will be emphasized.

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