Laboratoire de Mécanique des Fluides de Lille
Kampé de Fériet

Internship proposal

Modeling self-organizing phenomena by mechanical analogy

Supervisors: Francesco Romanò / Michael Riedl
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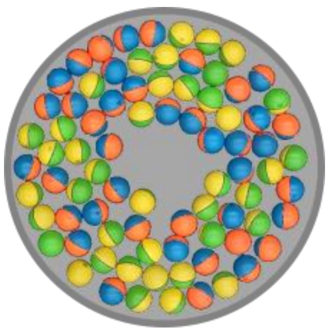
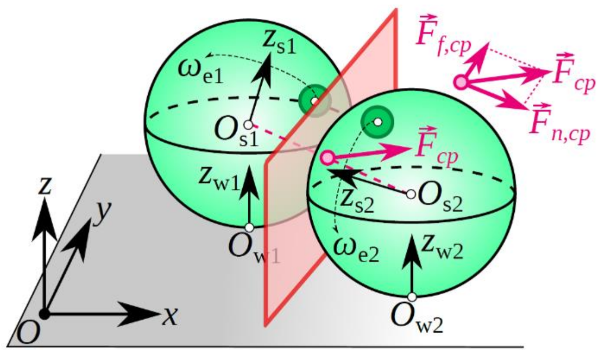
Location: ENSAM Lille, 8 Boulevard Louis XIV, 59046 Lille
Duration: 6 months
Level: M2
Expected knowledge (one or more among): fluid mechanics, biophysics, dynamical system theory, numerics
Expected hard skills: Proficiency in Python

Subject:

Biophysical systems are composed of individual building blocks, namely cells. Only the local interactions between neighboring units give rise to the collective behavior that renders them into what appears to the observer as a single entity. The emergent phenomenon of synchronization is fundamental to a range of such collective behaviors. Our proposed project is based on our recently published experimental model system of motorized spheres which are capable of reproducing the collective behavior observed in cell collectives. (follow the QR code for reference) The crucial strength of our mechanical analogy is that it can be fully controlled, hence avoiding the variability and complexity inherent to biological cells. This allows us to further investigate self-organization by controlling all the parameters involved in their dynamics. We propose to find a minimal analogous numerical model to provide the necessary insight into the biophysics of self-organization, ultimately allowing us to reverse engineer a desired collective behavior. The model to develop during the master's thesis will also be applicable to granular media, active matter, chemical oscillators and multibody problems.





Team:

This internship is developed within the framework of the collaboration between Francesco Romanò, Assoc. Prof. at ENSAM and expert in modeling and numerical simulations, and Michael Riedl, PostDoc fellow at TU Dresden and expert in self-organizing phenomena and experiments.

Preliminary organization of the work:

- Bibliographical study on self-organizing phenomena
- Development of the model and implementation of the simulation code
- Parametric study to investigate several conditions leading to collective behaviors
- Comparison of the numerical simulations with already available experimental evidence

Future plans: Based on the achievements of the project, a Ph.D. funding proposal will be submitted.