a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

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MECH 493 project: **Simulation and modelling of active matter systems**

Background and research goal

Active matter is a term used to describe matter that is composed of a large number of self-propelled active 'particles' that individually convert stored or ambient energy into systematic motion. The interaction of many of these individual active particles with each other or their environment can lead to complex collective dynamics. Biological examples include a flock of birds, a school of fish, or at smaller scales a suspension of bacteria or even the collective motion within a human cell. The study of such active matter is important in many bio-related applications including: the design of synthetic materials (bioengineering), models of population dynamics (bioremediation), the control of biofilm formation (biomedical), and alternative energy production (biofuels). Understanding the dynamics of active matter systems can ultimately lead to the careful design and control of synthetic active matter allowing for applications such as autonomous chemical sensing or the targeted delivery of payloads by synthetic autonomous active particles.

In the Soft Matter Group we develop mathematical models and computational tools using fast numerical methods to describe, and then design, dense active matter systems for applications ranging from health to energy. This includes scenarios where there are many interacting autonomous active particles exhibiting collective dynamics in fluid environments that may contain complex heterogeneous microstructure.

We have various projects involving modelling and simulation the dynamics of autonomous active particles. In particular, how to model and control the dynamics of synthetic or artifical microorganisms with the aim to be able to control the dynamics of large numbers of interacting autonomous active particles.

Tasks to be performed by the student

Read the relevant literature in the field (several good introductory monographs and reviews).

Develop mathematical models for active matter systems in inhomogeneous environments

Conduct numerical simulations and interpret results

Present their work to the group

Write a final report of their work

Facilities and team:

The student will work in my lab (CEME 1051) and interact with Ph.D. students and postdocs (depending on the particular task).