

Mathematical models for physics. Mathematical modelling for cell mechanics (R. Allena).

Cell mechanics plays a fundamental role in several mechanobiological phenomena such as bone remodelling, cancer , embryogenesis and immune response. During the last decades, biologists have started exploring the role of mechanics and more specifically of forces, stress and strains exerted and undergone by the cells on their environment. During this course we will review the basic principles of continuum mechanics in order to be able to address mathematical modelling for several biological processes such as adhesion, migration, invasion and cell-cell interactions. Various mathematical approaches based on ODEs, PDEs, diffusion-reaction equations or others will be presented in order to highlight how phenomena happening at different scales can be modelled and coupled to account for multiscale aspects. Specific focus will be on single and collective cell migration as well as nucleus mechanics.

- Part I
Fundamental concepts in continuum mechanics.
Solid mechanics.
- Part II
Introduction on cell mechanical properties.
Extra, inter and intracellular mechanisms involved in cell motility.
- Part III
Different models of single and collective cell migration: physical, mathematical and computational approaches.
- Part IV
Nucleus mechanics.