



CDB SEMINAR

Edouard Hannezo

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Tuesday, December 4, 2012

16:00~17:00 A7F Seminar Room

From mechanical instabilities of epithelial tissues to morphogenesis, stem cell dynamics and cancerogenesis

Summary

An essential property of living tissues is a permanent cell turnover due to cell division and cell death, which has important effects on their mechanical response. Since cells often grow and divide in a constrained environment, cellular divisions and apoptosis induce internal stresses in tissues that influence deeply their morphologies. Conversely, there is a mechanical feedback on cellular growth, differentiation, and organ development.

We study theoretically the shapes of a dividing epithelial monolayer of cells lying on top of a planar elastic stroma. The pressure created by cell division provokes a so-called buckling instability at a finite wavelength leading to the formation of periodic arrays of villi and crypts.

We then turn to mechanical instabilities of biological tubes. Several shapes are investigated, all of which are found in pathologies of tracheal or renal tubes as well as in arteries. The final shape depends crucially on a few mechanical parameters of the tissue. We produce a full phase diagram of tubular instabilities which could be a helpful guide for think about the underlying genetic regulation. Finally, we wish to understand the interplay between mechanics and stem cell dynamics. Taking again the intestinal crypt as a model system, we reproduce the experimentally observed, developmental dynamics of stem cells, using a very limited number of parameters. We then discuss the effect of mutations on the size of the proliferative compartment, in order to explore the morphological transition from a normal crypt to a polyp.

Reference

- Instabilities of Monolayered Epithelia: Shape and Structure of Villi and Crypts
Phys. Rev. Lett. 107, 078104 (2011)
Mechanical Instabilities of Biological Tubes
Phys. Rev. Lett. 109, 018101 (2012)

Host:

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Extended Informal discussion of this presentation is scheduled after this seminar. Everyone is welcome to attend. Refreshments and snacks will be served (at A5F Seminar Room).