Seminar/Talk

Complex Spatial Networks and Programmed Shape Selection: Topology and Geometry in Biology

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Nature finds the means to leverage complex geometric and topologic effects in many ways that are we only now beginning to understand. For example, in the case of topology, natural transport webs are frequently dominated by dense sets of nested cycles; the architecture of these networks -- the topology and edge weights -- determines how efficiently the networks perform their function. We present a new characterization of these physical networks that rests on an abstraction of a physical tiling in the case of a two dimensional network to an effective tiling of an abstract surface in space that the network may be thought to sit in. This new algorithmic approach can be used for automated phenotypic characterization of any weighted network whose structure is dominated by cycles, such as, for example, mammalian vasculature in the organs, the root networks of clonal colonies like quaking aspen, and the force networks in jammed granular matter. On the geometric side of the ledger, it has recently been more and more appreciated that developing biological systems employ complicated 2D stress fields during early onset of morphogenesis from flat or quasi-flat epithelial sheets to a rich zoo of fully three dimensional objects. We discuss a speculative approach based on methods from the physics of exotic shape-shifting materials to reduce the complexity of the interacting "parts" of the stress distribution to model these developmental morphomechanics in a parameter space of drastically reduced dimensionality.

Monday, July 9, 2018 11:00am - 12:15pm

Mondi Seminar Room 3, Central Building

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