Actin Spring

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The research story

Actin filaments are major actors of cell division, migration, morphological changes and other cellular processes. These cytoskeletal filaments, short, very dynamic and flexible, but numerous, assemble into higher level structures that contribute to those different processes. The specific organization of thousands of actin filaments in those different structures determine their ability to perform different tasks. Understanding how from the same biological entities, cells can build, use and disassemble such different structures in form and function is thus a major point in understanding cellular processes. To explore the auto-organization of actin filaments, controlled in-vitro reconstructions were performed by constraining actin filaments generation to given geometries. Filaments will grow and assemble reproducibly into structures determined by the imposed geometry [1]. However, despite the in-vitro control, the complexity of the system makes it difficult to explain the observed behavior and to establish the laws controlling filaments organization. To gain understanding of this emergent organization, we performed numerical simulations of such systems with the Cytosim software.

The image

This image is the result of one simulation of the auto-organization of actin filaments growing out of an 8 branch star geometry, similar as those performed in [2]. The image was directly generated from Cytosim and was converted to eps format with Gimp.

References

[1] Reymann AC, Martiel JL, Cambier T, Blanchoin L, Boujemaa-Paterski R, Théry M, Nucleation geometry governs ordered actin networks structures, Nature Materials 9(10): 827–832, 2010.

[2] Letort G, Politi AZ, Ennomani H, Théry M, Nédélec F, et al., Geometrical and mechanical properties control actin filament organization, PLoS Computational Biology 11(5): e1004245, 2015.

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