[Talk 7] Universality in single-layer filament network formation on surfaces

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A broad range of surface assembly processes exhibit growth of straight filaments whose direction is guided by the lattice symmetry of the underlying substrate. Filament growth stops when its end encounters another filament. Examples include formation of biofilament networks, opto-electronic fiber growth, and planar fragmentation in geophysics. We call this process as Orientational Linear Epitaxy (OLE). Using mean field and stochastic simulation descriptions, we show that the filament length distribution crosses over from exponential for long filaments to a power law for shorter filaments. To compare with experiments, we develop a Computer-Aided Feature Extraction (CAFE) program that can recognize and measure individual filaments in images of surface filament networks. Analyzing atomic force microscopy images of collagen networks by CAFE shows good agreement with the theory regarding the power law exponent for the filament length distribution. In addition to the applicability of our theory to other systems driven by OLE, our CAFE program can be used for quantitative image-based analysis of various complex systems.