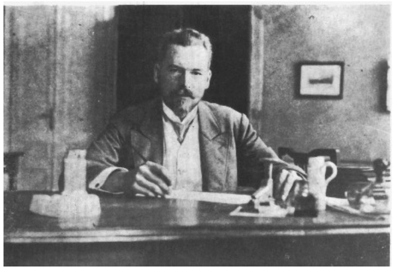

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Deterministic Loewner equation and unstable growth processes

Tuesday, 4 September 2018 15:15 (45 minutes)

The Loewner equation in its stochastic incarnation has proved to be an insightful method in studying scaling limits of critical two-dimensional lattice models in statistical mechanics. However, a deterministic counterpart of this equation is also a valuable tool, particularly well-suited for the description of diffusion-controlled growth problems, such as electrodeposition, dielectric breakdown or viscous fingering [1-3]. In this communication, we use this formalism to describe the growth of finger-like protrusions driven by the gradient of a harmonic field. Following Carleson and Makarov [1] we assume that the growth takes place only at the tips of long-and-thin fingers. However, in contrast to [1], we allow the fingers to split, which is crucial to obtain the patterns corresponding to those observed in nature. We discuss different splitting criteria and study the dynamics of the model in variety of geometries. In particular, we demonstrate that tip-splitting instability of the growing fingers can lead to the stable, regular movement of the envelope of the growing structure [4]. Finally, we show how this formalism can be applied to the evolution of the river networks [5-7] and demonstrate that it correctly predicts the branching angle between the streams to be 72 degrees.

1. L. Carleson and N. Makarov, *Laplacian path models*, J. Anal. Math. **87**, 103 (2002)
2. T. Gubiec, P. Szymczak, *Fingered growth in channel geometry: A Loewner equation approach* ,Phys. Rev. E, **77** , 041602 (2008)
3. M. Pecelerowicz, A. Budek, P. Szymczak, *Effective description of the interaction between anisotropic viscous fingers*, EPL, **108**, 14001 (2014)
4. M. Pecelerowicz, P. Szymczak, *Stabilizing effect of tip-splitting on the interface motion*, Phys. Rev. E, **94**, 062801 (2016)
5. O. Devauchelle, A. P. Petroff, H. F. Seybold, and D. Rothman, *Ramification of stream networks*, Proc. Natl. Acad. Sci. USA, **109**, 20832 (2012)
6. Y. Cohen, O. Devauchelle, H. F. Seybold, R. S. Yi, P. Szymczak, D. Rothman, *Path selection in the growth of rivers*, Proc. Natl. Acad. Sci. USA, **112**, 14132 (2015)
7. O. Devauchelle, P. Szymczak, M. Pecelerowicz, Y. Cohen. H. Seybold, D. H. Rothman, *Laplacian networks: Growth, local symmetry and shape optimization*, Phys. Rev. E, **95**, 033113 (2017)

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