

MAR17-2016-020468

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Isometric immersions and self-similar buckling in elastic sheets.¹

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The edges of torn elastic sheets and growing leaves often display hierarchical self-similar like buckling patterns. On the one hand, such complex, self similar patterns are usually associated with a competition between two distinct energy scales, e.g. elastic sheets with boundary conditions that preclude the possibility of relieving in plane strains, or at alloy-alloy interfaces between distinct crystal structures. On the other hand, within the non-Euclidean plate theory this complex morphology can be understood as low bending energy isometric immersions of hyperbolic Riemannian metrics. In particular, many growth patterns generate residual in-plane strains which can be entirely relieved by the sheet forming part of a surface of revolution or a helix. In this talk we will show that this complex morphology (i) arises from isometric immersions (ii) is driven by a competition between the two principal curvatures, rather than between bending and stretching. We identify the key role of branch-point (or monkey-saddle) singularities, in complex wrinkling patterns within the class of finite bending energy isometric immersions. Using these defects we will give an explicit construction of strain-free embeddings of hyperbolic surfaces that are fractal like and have lower elastic energy than their smooth counterparts

¹US-Israel BSF grant 2008432. NSF grant DMS-0807501. NSF-RTG grant DMS-1148284.