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An Elastic Model of Blebbing in Nuclear Lamin Meshworks[1]
CHLOE FUNKHOUSER, Northwestern University, RASTKO SKNEPNEK, Syracuse University, Northwestern University, TAKESHI SHIMI, ANNE GOLDMAN, ROBERT GOLDMAN, MONICA OLVERA DE LA CRUZ, Northwestern University — A two-component continuum elastic model is introduced to analyze a nuclear lamin meshwork, a structural element of the lamina of the nuclear envelope. The main component of the lamina is a meshwork of lamin protein filaments providing mechanical support to the nucleus and also playing a role in gene expression. Abnormalities in nuclear shape are associated with a variety of pathologies, including some forms of cancer and Hutchinson-Gilford progeria syndrome, and are often characterized by protruding structures termed nuclear blebs. Nuclear blebs are rich in A-type lamins and may be related to pathological gene expression. We apply the two-dimensional elastic shell model to determine which characteristics of the meshwork could be responsible for blebbing, including heterogeneities in the meshwork thickness and mesh size. We find that if one component of the lamin meshwork, rich in A-type lamins, has a tendency to form a larger mesh size than that rich in B-type lamins, this is sufficient to cause segregation of the lamin components and also to form blebs rich in A-type lamins. The model produces structures with comparable morphologies and mesh size distributions as the lamin meshworks of real, pathological nuclei.

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