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Title: Generating morphological models of endothelial monolayers from limited data:
A computational framework for mechanobiology to understand and predict cell behaviors

Abstract:
The following is a major question in mechanomedicine: How is force transmitted through either a single endothelial cell (intra-cellular force) or between endothelial cells (inter-cellular force) that constitute a monolayer? The reason for this question is cell shape, intra- and inter-cellular force, and function are closely related. This relationship is an important determinant of cellular behavior and what goes wrong in cells during disease. We are using a single fluorescent label on live cells to predict the 3D shape/morphology of human microvascular endothelial cells (HMEC-1), generate 3D spatial models of HMEC-1 using both statistical models and machine learning, generate computational models of the cells to quantify the dynamic mechanical forces—important to cutaneous wound healing and the development of development of novel mechanotherapies. The impact of this research could be far-reaching: (i) This experimental and computational framework could help scientist—from several fields including wound healing, tissue engineering and regenerative medicine, cardiovascular disease, and cancer biology—better understand what goes wrong in cells during disease; and, (ii) The framework developed in this proposal is not limited to a specific cell type, but could be adapted for any adherent cell.