Abstract Submitted
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Computational Characterization of Type I collagen-based Extracellular Matrix[1] LONG LIANG, Department of Physics, Arizona State University, CHRISTOPHER ALLEN RUCKSACK JONES, DANIEL LIN, Department of Physics, Oregon State University, YANG JIAO, Department of Materials Science and Engineering, Arizona State University, BO SUN, Department of Physics, Oregon State University — A model of extracellular matrix (ECM) of collagen fibers has been built, in which cells could communicate with distant partners via fiber-mediated long-range-transmitted stress states. The ECM is modeled as a spring-like fiber network derived from skeletonized confocal microscopy data. Different local and global perturbations have been performed on the network, each followed by an optimized global Monte-Carlo (MC) energy minimization leading to the deformed network in response to the perturbations. In the optimization, a highly efficient local energy update procedure is employed and force-directed MC moves are used, which results in a convergence to the energy minimum state 20 times faster than the commonly used random displacement trial moves in MC. Further analysis and visualization of the distribution and correlation of the resulting force network reveal that local perturbations can give rise to global impacts: the force chains formed with a linear extent much further than the characteristic length scale associated with the perturbation sites and average fiber length. This behavior provides a strong evidence for our hypothesis of fiber-mediated long-range force transmission in ECM networks and the resulting long-range cell-cell mechanical signaling.

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