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Physical limits to biomechanical sensing in disordered fiber networks FARZAN BEROZ, Princeton Univ, LOUISE JAWERTH, STEFAN MNSTER, MPI PKS Dresden, DAVID WEITZ, Harvard, CHASE BROEDERSZ, Ludwig-Maximillians University Munich, NED WINGREEN, Princeton — Cells actively probe and respond to the stiffness of their surroundings. Since mechanosensory cells in connective tissue are surrounded by a disordered network of biopolymers, their mechanical environment can be extremely heterogeneous. Here, we investigate how this heterogeneity impacts mechanosensing by modeling the cell as an idealized local stiffness sensor inside a disordered fiber network. For all types of networks we study, including experimentally-imaged collagen and fibrin architectures, we find that measurements applied at different points yield a strikingly broad range of local stiffnesses, spanning roughly two decades. We verify via simulations and scaling arguments that this broad range of local stiffnesses is a generic property of disordered fiber networks. Finally, we show that to obtain optimal, reliable estimates of global tissue stiffness, a cell must adjust its size, shape, and position to integrate multiple stiffness measurements over extended regions of space.

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