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Redundancy and cooperativity in the mechanics of compositely crosslinked cytoskeletal networks J.M. SCHWARZ, Physics Department, Syracuse University, D.Q. QUINT, School of Natural Sciences, University of California-Merced, MOUMITA DAS, Physics Department, Syracuse University — The cytoskeleton contains many types of crosslinkers. Some crosslinkers allow free rotations between filaments and others do not. The mechanical interplay between different crosslinkers is an open issue in cytoskeletal mechanics. Therefore, we develop a theoretical framework based on rigidity percolation to study a generic filamentous system containing both stretching and bond-bending forces to address this issue. The framework involves both analytical calculations via effective medium theory and numerical simulations on a percolating triangular lattice with very good agreement between both. We find that the introduction of angle-constraining crosslinkers to a semiflexible filamentous network with freely-rotating crosslinks can cooperatively lower the onset of rigidity to the connectivity percolation threshold—a result speculated for years but never before obtained via effective medium theory. In other words, the system can attain rigidity at the lowest concentration of material possible. We further demonstrate that introducing angle-constraining crosslinks results in mechanical behaviour similar to just freely-rotating crosslinked semflexible filaments, indicating redundancy. Our results also impact upon collagen and fibrin networks in biological and bio-engineered tissues.

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