Common features in the mechanics of fiber networks, spring networks, and emulsions

Baumgarten, Karsten; Tighe, Brian

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Common features in the mechanics of fiber networks, spring networks, and emulsions[1] KARSTEN BAUMGARTEN, BRIAN P. TIGHE, TU Delft — In many soft matter systems with a network structure, the mean connectivity plays a key role in determining the mechanical response. In the typical scenario for central force networks, there is a critical connectivity (the isostatic point) above which the system can withstand shear and bulk deformations. However, there are several different ways to induce the material to rigidify below the critical connectivity. Here we explore three such mechanisms: bending rigidity in the Mikado model for semi-flexible fiber networks, pre-tensioning in random spring networks, and finite-ranged attraction in soft sphere packings. Here we show common features in the rigidity transition of all three seemingly disparate systems. In particular we identify a band of low frequency normal modes for low perturbation strengths whose height and width are related to the distance to isostaticity. These in turn control the elastic moduli, as we explain with simple scaling arguments.

[1]Dutch Organization for Scientific Research (NWO)

Karsten Baumgarten
TU Delft

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