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Topology effects on prestrained elastic networks

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Elastic networks composed by masses linked by linear springs have been widely used to model processes ranging from deformation in crystal lattices to tumor growth. However, in most studies the emphasis has been placed on the different characteristics of the springs and on the nature of prestrain, while topological features have been mostly neglected. Here we report a systematic numerical analysis showing that topology-based metrics, e.g. the network average coordination number, significantly affect the mechanical response of prestrained elastic networks. In particular we show that, on average, prestrained networks contract while reaching equilibrium and that the amount of contraction shows a global maximum around what is known as "rigidity threshold". We also discuss an analogy between the behaviour of an elastic network and the "consensus algorithm" used in multiagent robotics, suggesting that the same framework can be used to improve coordination within a team of robots.

Keywords: Elastic networks, Prestrain, Topological measures of networks, Robotic consensus