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# Architected Fibrous Networks with Highly Tuneable Properties

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# Architected fibrous networks with highly tuneable properties

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Fibrous networks with random structure are ubiquitous in our everyday lives. From biological structures, such as the cellular cytoskeleton and connective tissue, to man-made structures including rubber, paper and non-wovens, fibrous materials are the structural building block of many material systems. The reasons for this prevalence are: (a) networks are lightweight structures, (b) are non-continuum materials, which insures exceptional properties not encountered in regular engineering materials, (c) exhibit large sensitivity to structural controllable parameters, which enables broadly tuneable properties.

In this work we identify the origins of this highly tuneable behaviour in the context of random 'homogeneous' networks, made from a single type of fiber [1], and of 'composite' networks, made from multiple fiber types [2]. The global behaviour of interest includes the small strain stiffness, non-linear elastic behaviour under large deformations, and the overall network strength. The controllable parameters of the structure are both stochastic and deterministic and include the density and spatial density fluctuations of the various types of fibers used, the degree and type of cross-linking, aspects of network architecture, and fiber properties. It will be shown how, by controlling the degree of heterogeneity of the structure, the global material properties can be adjusted in a broad range, often with small variations of certain control parameters. Preserving the overall stochastic nature of these structures insures on one hand their manufacturability and, on the other hand, relevance for biological applications [3].

## References

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