On Characterization of an Elastic Network of Orthogonal Inextensible Fibers with Stiff Knots Using the Six-Parameter Shell Theory

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Abstract: Within the framework of the six-parameter nonlinear shell theory we discuss the deformations of an elastic network made of two orthogonal families of inextensible fibers rigidly connected each other at contact points. In other word we consider a discrete system similar to fishing net with stiff knots. The main idea is to replace the analysis of deformations of such discrete system by homogeneous shell model using the six-parameter shell theory. Within this theory a shell is modelled as a deformable oriented surface with two kinematic fields that are translations and rotations. For the shell model the efficient FEM analysis are performed recently. So, we try to use this tool to model the general deformations of the network.

We introduce the general model of a shell with specific type of symmetry and constraints of inextensibility in two orthogonal directions and compare this model with discrete model of an elastic network. Each fiber is modelled using Cosserat curve model with constraint of inextensibility. The relations between material parameters of two models are discussed.

Author acknowledges the support by the People Program (Marie Curie Curie ITN transfer) of the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No PITN-GA-2013-606878.

Key words: elastic network, inextensible fibers, six-parameter shell theory, micropolar shell