Simulating Nonlinear Elastic Behaviour of Cables Using an Iterative Method

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This contribution introduces a novel approach to simulate the nonlinear elastic bending behaviour of cables. Although a linear elastic constitutive model is suitable for many applications with rather simple cables or hoses, for more complex cables, e.g. high-voltage cables, we aim to enable nonlinear elastic behaviour. Cyclic pure bending experiments [1] as well as MeSOMICS bending tests [2] on real cables, clearly showed the existence of nonlinear constitutive bending behaviour.

In our current framework [3] of utilizing Cosserat rod theory, static equilibrium states of cables under given boundary conditions are obtained efficiently by energy minimization, where elastic energy densities are used. The latter are characterized by locally constant effective stiffness parameters. In order to enable nonlinear bending behaviour within the current framework, we propose an iterative method. In this method, we update the local bending stiffness constants according to a given characteristic. This update is applied iteratively until energy minimum is reached.

We performed several numerical experiments with various bending stiffness characteristics to demonstrate the benefit of the described approach. Current research focusses on the inverse problem, i.e. to determine the nonlinear bending characteristic from real bending experiments with MeSOMICS [2].

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