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Data-Driven Optimization Approach for Mass-Spring Models Parametrization Based on Isogeometric Analysis

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Abstract

The development of a systematic procedure to set up the parameters in a Mass-Spring Model (MSM) remains an open problem because the model parameters are not related to the constitutive laws of elastic material in an obvious way. One possibility to address this problem is to calculate MSM parameters from a reference model based on continuum mechanics and finite element (FEM) techniques. The traditional approaches in this area use isoparametric FEM, with linear shape functions, as the reference model. Recently, Isogeometric Analysis (IGA) has been used as new method for the analysis of problems governed by partial differential equations where Non-uniform Rational B-Splines (NURBS) are considered as basis of the analysis. Therefore, in this paper we propose a new method to derive MSM parameters using a data-driven strategy based on IGA approach. In this way, we propose a methodology for MSM derivation that is not restricted to a particular mesh topology and can consider higher order polynomial interpolation functions using the NURBS machinery. We validate the methodology for deriving MSM systems to simulate 2D/3D deformable objects. The obtained results are compared with related works in order to show the efficiency of our technique. We also discuss its robustness and issues against dif-

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