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Our study focuses on finding the natural shape of a given hanging deformed isotropic rod, made of a known material, the input shape is described as a mere geometric curve that we subsequently frame to compute a material curvature field and feed our inverse problem. We prove that the natural shape of the rod satisfying equilibrium exists and is unique, regardless of the infinity compatible frames for the input curve. The natural shape is computed efficiently by solving in sequence three linear initial value problems. We illustrate our theoretical results trough numerical examples of well known curves to which we apply our inverse procedure. By direct simulation we show that indeed those natural shapes fall, under the effect of gravity, onto the expected equilibrium. We stress on the fact that the obtained rest shapes are complex and far from intuitive. We complement this study with experimental corroborations. By means of a standard array of cameras, we spatially reconstruct real elastic hanging rods with welldefined geometrical features. We find some good agreements with model prediction despite the experimental limitations on the estimation of the curvature fields of the rod's center line.
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