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Stephen Preston - Isometric immersions and the waving of flags

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A physical flag can be modeled geometrically as an isometric immersion of a rectangle into space, with one edge fixed along the flagpole. Its motion, in the absence of gravity and wind, can be modeled as a geodesic in the space of all isometric immersions, where the Riemannian metric is inherited from the kinetic energy on the much larger space of all immersions. In this talk I will show how generically such an isometric immersion can be described completely by the curve describing the top or bottom edge, which gives a global version of a classical local result in differential geometry. Using this, I will show how to derive the geodesic equation, which turns out to be a highly nonlinear, nonlocal coupled system of two wave equations in one space variable, with tension determined by solving an ODE system. The new model has the potential to describe motion of cloth with much fewer variables than the traditional method of strongly constraining three functions of two space variables.

This is joint work with Martin Bauer and Jakob Moeller-Andersen