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<tr><th>authors</th><td>Peter W. Michor
Philipp Harms
Martin Bauer</td></tr>
<tr><th>title</th><td>Sobolev metrics on shape space of surfaces</td></tr>
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<tr><th>journal</th><td>American Institute of Mathematical Sciences (AIMS)</td></tr>
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<tr><th>urls</th><td>https://web.archive.org/web/20120117155217/http://www.mat.univie.ac.at/~michor/surfaces-sobolev.pdf</td></tr>
<tr><th>id</th><td>id8167078544419475318</td></tr>
<tr><th>abstract</th><td>Let M and N be connected manifolds without boundary with (M) < (N), and let M compact. Then shape space in this work is either the manifold of submanifolds of N that are diffeomorphic to M, or the orbifold of unparametrized immersions of M in N. We investigate the Sobolev Riemannian metrics on shape space: These are induced by metrics of the following form on the space of immersions: G^P_f(h,k) = â^«_M(P^f h, k) (f^*) where is some fixed metric on N, f^* is the induced metric on M, h,k â^^Î“(f^*TN) are tangent vectors at f to the space of embeddings or immersions, and P^f is a positive, selfadjoint, bijective scalar pseudo differential operator of order 2p depending smoothly on f. We consider later specifically the operator P^f=1 + AÎ”^p, where Î” is the Bochner-Laplacian on M induced by the metric f^*gÌ…. For these metrics we compute the geodesic equations both on the space of immersions and on shape space, and also the conserved momenta arising from the obvious symmetries. We also show that the geodesic equation is well-posed on spaces of immersions, and also on diffeomorphism groups. We give examples of numerical solutions.</td></tr>
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<tr><th>title</th><td>Sobolev metrics on shape space of surfaces</td></tr>
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<tr><th>abstract</th><td>Many procedures in science, engineering and medicine produce data in the form of geometric shapes. Mathematically, a shape can be modeled as an un-parameterized immersed sub-manifold, which is the notion of shape used here. Endowing shape space with a Riemannian metric opens up the world of Riemannian differential geometry with geodesics, gradient flows and curvature. Unfortunately, the simplest such metric induces vanishing path-length distance on shape space. This discovery by Michor and Mumford was the starting point to a quest for stronger, meaningful metrics that should be able to distinguish salient features of the shapes. Sobolev metrics are a very promising approach to that. They come in two flavors: Outer metrics which are induced from metrics on the diffeomorphism group of ambient space, and inner metrics which are defined intrinsically to the shape. In this work, Sobolev inner metrics are developed and treated in a very general setting. There are no restrictions on the dimension of the immersed space or of the ambient space, and ambient space is not required to be flat. It is shown that the path-length distance induced by Sobolev inner metrics does not vanish. The geodesic equation and the conserved quantities arising from the symmetries are calculated, and well-posedness of the geodesic equation is proven. Finally examples of numerical solutions to the geodesic equation are presented.</td></tr>
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