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On the 2-point problem for the Euler-Lagrange equations

New Abstract: Consider the motion of the ideal incompressible fluid on a compact 2-d manifold M. It is described by the Euler-Lagrange equations. For every initial velocity field v there is a unique 1-parameter family of area-preserving diffeomorphisms $g_t : M \to M$. The time-1 diffeomorphism g_1 is defined by the initial velocity v and is denoted by Exp_v. The map $v \mapsto Exp_v$ is the geodesic exponential map on the group $D(M)$ of area-preserving diffeomorphisms. The main result of the talk is the following

Theorem: for any $ginD$ there exists a vector field v such that $g = Exp_v$.

This theorem looks superficially like the Hopf-Rinow theorem in the finite-dimensional geometry. However, it has little to do with the Hopf-Rinow Theorem, and the proof is based on completely different ideas.