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An optimal transport Lagrangian approach for the Camassa-Holm variational model

In this talk I will consider a multi-dimensional generalization of the Camassa-Holm variational fluid model, describing geodesics on the group of diffeomorphisms with respect to the $H(div)$ metric. Such a model has been recently reformulated as a geodesic equation for the L^2 metric on a subgroup of the diffeomorphism group of the cone over the domain. This point of view is fruitful for several reasons. On one hand, it allows one to give a precise definition to solutions of the relative boundary value problem (in which the final configuration of fluid particles is provided instead of their initial velocity). On the other hand, it can be used to generate a simple Hamiltonian particle-based discretization of the initial value problem using semi-discrete unbalanced optimal transport. This approach further develops a similar one proposed for the incompressible Euler equations, by including compressibility effects. I will present our methodology together with some numerical results illustrating the behaviour of the scheme.