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How to differentiate functionals involving higher order derivatives along geodesics

I will describe work with Benjamin Schachter on differentiating functionals along Wasserstein geodesics, using an Eulerian point of view. The cost functions $c(x,y)$ we consider are defined by minimizing the integral of a suitable Lagrangian among paths from x to y . We develop a formal procedure for computing derivatives of arbitrary order, and then appeal to the theory of transport equations (first-order linear PDE) to prove that the functionals vary smoothly along the geodesics, even when the density itself is not smooth. (Based on Ben's 2017 Ph.D. thesis)