Atelier
« Méthodes de calcul pour le transport optimal
18—22 juillet 2016

Workshop
"Computational Optimal Transportation"
July 18—22, 2016

A fast numerical solver for semi-discrete L2 optimal transport

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I present several algorithmic improvements for computing the L2 optimal transport map between a piecewise linear density and a sum of Dirac masses in 3D. In this setting, it is well known that the pre-images of each Dirac mass corresponds to a Laguerre diagram, determined by the Kantorovich potential at each Dirac mass. The set of potentials can be determined by extremizing a concave function [Alexandrov, Aurenhammer, Brenier]. This viewpoint can be turned into an effective numerical solution mechanism [Merigot, L]. To implement a numerical solution mechanism, one needs efficient ways of computing the objective function and its derivatives. In practice, this means compute integrals on the intersection between the Laguerre diagram and the tetrahedral mesh that supports the input piecewise linear density. For the geometric part of the computation (intersection), I propose to replace the exact predicates and symbolic perturbation that I previously used with a much simpler combinatorial algorithm. Besides faster execution time, it makes the implementation much simpler and easier to reproduce. I also present an algorithm to quickly compute the sparsity pattern of the Hessian, that can be used to replace the L-BFGS solver with the more efficient Newton solver previously experimented in 2D [Merigot].

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