Efficient Sparse Multi-Scale Methods for Optimal Transport

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January 11, 2017

The linear programming formulation of optimal transport due to Kantorovich is flexible, well suited for discretization and allows for numerically robust solvers. However, large dense problems are practically infeasible for standard algorithms due to run-time and memory demand.
We discuss a hierarchical multi-scale scheme, solving large problems from coarse to fine, allowing us to focus on relevant sparse sub-problems at finer scales, which drastically reduces the problem size. A key challenge is to retain (near) global optimality for the original dense problem.
For this we propose two approaches, both leveraging the geometry of the underlying transport cost. One is based on consistent discretization of local optimality criteria from the continuous problem, the other is based on suitable combination of the multi-scale scheme with entropy regularization techniques.