Convergence rate of entropy-regularized multi-marginal optimal transport costs

Luca Nenna
(LMO) Université Paris-Saclay, France
luca.nenna@universite-paris-saclay.fr

We investigate the convergence rate of multi-marginal optimal transport costs that are regularized with the Boltzmann-Shannon entropy, as the noise parameter ε tends to 0. We establish lower and upper bounds on the difference with the unregularized cost of the form $C\varepsilon\, log(1/\varepsilon) + O(\varepsilon)$ for some explicit dimensional constants C depending on the marginals and on the ground cost, but not on the optimal transport plans themselves. Upper bounds are obtained for Lipschitz costs or costs with Lipschitz gradient, and lower bounds for $\mathcal{C}^2$ costs satisfying some signature condition on the mixed second derivatives that may include degenerate costs, thus generalizing results previously obtained by Carlier, Pegon, Tamanini and Eckstein, Nutz in the 2-marginal case and for non-degenerate costs. We obtain in particular matching bounds in some typical situations where the optimal plan is deterministic, like in the case of Wasserstein barycenters.

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