ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ

ΤΜΗΜΑ ΜΑΘΗΜΑΤΙΚΩΝ

Εβδομαδιαίο Σεμινάριο

Quantum correlations and optimal transport

Gero Friesecke

TU München, Germany

I will begin by explaining a recently discovered [1] link between quantum correlations and optimal transport, without assuming familiarity with either. More precisely, in a dilute scaling limit, position correlations between N quantum particles (say, electrons in a molecule) are described by a Kantorovich optimal transport problem. Unlike in usual OT problems (as discussed in the books by Villani), one needs to prescribe N instead of 2 marginals (the probability distributions of the indivdual electrons), and the cost is not a positive but a negative power of the distance (-1, corresponding to Coulomb repulsion, instead of 2).
Next, I will explain that for more than 2 marginals, the familiar two-marginal result that "Monge = Kantorovich" fails, i.e. the infimum of the Monge problem can be strictly bigger than the minimum of the Kantorovich problem [2]. I will close by presenting a new ansatz [3] for the discretized multi-marginal OT problem which - unlike the Monge ansatz - always yields the minimum Kantorovich cost, but whose computational complexity scales linearly instead of exponentially with the number of particles/marginals.
[1] C.Cotar, G.F., C.Klueppelberg, Density functional theory and optimal transportation with Coulomb cost, Comm. Pure Appl. Math. 66, 548-599, 2013
[2] G.Friesecke, A simple counterexample to the Monge ansatz in multi-marginal optimal transport, convex geometry of the set of Kantorovich plans, and the Frenkel-Kontorova model, 2018 https://arxiv.org/abs/1808.04318
[3] G.Friesecke, D.Vögler, Breaking the curse of dimension in multi-marginal Kantorovich optimal transport on finite state spaces, SIAM J. Math. Analysis Vol. 50 No. 4, 3996-4019, 2018

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