Optimization on discrete probability spaces and applications

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This talk addresses the optimization of discrete probability distributions based on the natural gradient method. The space of probability distributions is endowed with a Fisher metric and it is shown that, with this metric, the natural gradient can be computed from the Euclidean gradient very easily with linear computational complexity. It is shown that the natural gradient flow satisfies probability constraints, thus enabling the optimization to be performed as an unconstrained optimization problem. For some distance/divergence functions, for which the Fisher information matrix is its local second order approximation (e.g., Kullback-Leibler), the natural gradient method can be seen as a quasi-Newton method with respect to the Euclidean metric, and thus presenting fast convergence.

This framework is applied to a probabilistic control problem showing its practical feasibility in high dimensional problems.