A Simple, Electrical, Gradient Descent Algorithm for Approximate Max Flow

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The breakthrough work of Christiano et al. in 2010 showed how to compute a (1+eps)-approximate st-maximum flow in an undirected graph in O(mn^{1/3}poly(1/eps)) time. Their algorithm reduces the problem to finding a small number of st-electrical flows, which are combined using the multiplicative weights update method and computed using fast Laplacian solvers.

In this talk I will describe a different way to combine electrical flows to obtain an approximate max flow. The algorithm is based on a geometric / convex programming formulation of the problem, and amounts to performing projected gradient descent in which the Euclidean projections correspond to certain non-st electrical flows. By applying a standard acceleration scheme due to Nesterov, we obtain a slightly faster algorithm than Christiano et al. in the uncapacitated case . The main point, however, is the simplicity of the algorithm and its proof, and the geometric perspective used to formulate and analyze it.

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