Dynamic Network Energy Management via Proximal Message Passing

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- Final FnT article
- Talk Slides
- Short talk slides with no equations (!)

We consider a network of devices, such as generators, fixed loads, deferrable loads, and storage devices, each with its own dynamic constraints and objective, connected by AC and DC lines. The problem is to minimize the total network objective subject to the device and line constraints, over a given time horizon. This is a large optimization problem, with variables for consumption or generation for each device, power flow for each line, and voltage phase angles at AC buses, in each time period. In this paper we develop a decentralized method for solving this problem called *proximal message passing*. The method is iterative: At each step, each device exchanges simple messages with its neighbors in the network and then solves its own optimization problem, minimizing its own objective function, augmented by a term determined by the messages it has received. We show that this message passing method converges to a solution when the device objective and constraints are convex. The method is completely decentralized, and needs no global coordination other than synchronizing iterations; the problems to be solved by each device can typically be solved extremely efficiently and in parallel. The method is fast enough that even a serial implementation can solve substantial problems in reasonable time frames. We report results for several numerical experiments, demonstrating the method's speed and scaling, including the solution of a problem instance with over 30 million variables in 5 minutes for a serial implementation; with decentralized computing, the solve time would be less than one second.