Distributed Estimation via Dual Decomposition

S. Samar, S. Boyd, and D. Gorinevsky

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The focus of this paper is to develop a framework for distributed estimation via convex optimization. We deal with a network of complex sensor subsystems with local estimation and signal processing. More specifically, the sensor subsystems locally solve a maximum likelihood (or maximum a posteriori probability) estimation problem by maximizing a (strictly) concave log-likelihood function subject to convex constraints. These local implementations are not revealed outside the subsystem. The subsystems interact with one another via convex coupling constraints. We discuss a distributed estimation scheme to fuse the local subsystem estimates into a globally optimal estimate that satisfies the coupling constraints. The approach uses dual decomposition techniques in combination with the subgradient method to develop a simple distributed estimation algorithm. Many existing methods of data fusion are suboptimal, *i.e.*, they do not maximize the log-likelihood exactly but rather 'fuse' partial results from many processors. For linear gaussian formulation, least mean square (LMS) consensus provides optimal (maximum likelihood) solution. The main contribution of this work is to provide a new approach for data fusion which is based on distributed convex optimization. It applies to a class of problems, described by concave log-likelihood functions, which is much broader than the LMS consensus setup.