Distributed Estimation via Random Access

Animashree Anandkumar, *Student Member, IEEE,*, Lang Tong†, *Fellow, IEEE* and Ananthram Swami *Senior Member, IEEE*

Abstract

The problem of distributed Bayesian estimation is considered in the context of a wireless sensor network. Under a communication scheme known as the Type-Based Random Access, an estimation performance metric is defined in terms of the expected Fisher Information normalized by the transmission rate. Given an energy budget, an optimal spatio-temporal allocation scheme maximizing the performance metric is characterized. It is shown that the metric is crucially dependent on the channel coherence index. For channels with small coherence indices, sensor transmissions tend to cancel each other, and there exists an optimal mean transmission rate which maximizes the metric under an energy constraint. For channels with high coherence indices, on the other hand, there should be as many simultaneous transmissions as allowed by the network. The presence of a critical coherence index is established.

†Corresponding author.

A.Anandkumar and L.Tong are with the School of Electrical and Computer Engineering, Cornell University, Ithaca, NY 14853. Email:{aa332@,ltong@ece.}cornell.edu.

A. Swami is with the Army Research Laboratory, Adelphi, MD 20783 USA (e-mail: a.swami@ieee.org).

This work was supported in part through the collaborative participation in the Communications and Networks Consortium sponsored by the U. S. Army Research Laboratory under the Collaborative Technology Alliance Program, Cooperative Agreement DAAD19-01-2-0011 and by the National Science Foundation under Contract CNS-0435190. The U. S. Government is authorized to reproduce and distribute reprints for Government purposes notwithstanding any copyright notation thereon.