

Distributed Parameter Estimation for Monitoring Diffusion Phenomena Using Physical Models

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Abstract

In this work we address the problem of estimating parameters of diffusion phenomena via autonomous wireless sensor networks. Diffusion phenomena, such as the propagation of a gas in the air or of a chemical agent in the water, can be modeled by means of partial differential equations (PDE's). In several scenarios, the parameters characterizing such models, i.e. the coefficients of the PDE's, are not known a-priori and need to be estimated. We develop an adaptive approach for the distributed identification of the parameters of diffusion models for both the cases of known and unknown boundary conditions (BC's). The technique also applies to the case of spatially varying parameters. We present simulation results to show the performance and the various trade-offs of the method.

Keywords—Sensor networks, physical models, partial differential equations, diffusion phenomena, distributed identification, prediction, data gathering.