D-optimum hybrid sensor network deployment for parameter estimation of spatiotemporal processes

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Abstract

Process control often requires models in which non-negligible spatial dynamics has to be included in addition to the temporal one. Modelling then involves partial differential equations and a major difficulty in model calibration is the impossibility to measure process variables over the entire spatial domain. This leads to the question of how to optimally place sensors. Many sensor placement strategies have been developed [2]. They usually exploit the *Fisher information matrix* associated with the parameters to be identified. A revived interest in optimal sensor location is correlated with advances in *Sensor Networks* (SNs) which highly increase the flexibility of observation systems [1].

In this talk, a SN is considered which includes a number of mobile nodes which can move in a given spatial domain and, therefore, we would like their trajectories to be optimal in a sense. In addition to that, the data from mobile sensors are to be complemented by the ones gathered by a given number of nodes selected from among a greater number of nodes whose locations in space are fixed. Therefore, a decision must be made about which subset of non-mobile sensors is to be activated. Mathematically, the problem is a mixed discrete optimal control one and, due to its potential high dimensionality, naive solutions are deemed to failure. We apply the branch-and-bound method to drastically reduce the search space. The key idea behind it is alternation between two relaxed problems, namely a discrete optimization one related to stationary sensors and an optimal control one associated with moving sensors.

Keywords

D-optimality, Spatiotemporal process, Sensor network, Branch and bound.

References

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