

Energy-efficient data fusion in Gauss-Markov random field

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Abstract

The problem of routing for optimal detection of a Gauss-Markov random field (GMRF) with nearest-neighbor dependency graph is analyzed. Assuming an optimal log-likelihood ratio (LLR) detector at a designated cluster-head, routing schemes with data fusion which minimize the total-energy consumption are analyzed. It is shown that optimal routing with data fusion occurs in two stages *viz.*, a likelihood-computation and a likelihood-aggregation phase. During the likelihood-computation phase, local transmissions of correlated sensor observations occur between the neighbors of the dependency graph, thereby enabling the computation of local contributions to the LLR. During the likelihood-aggregation phase, these local contributions are aggregated and delivered to the cluster-head. It is shown that the optimal-transmission graph contains both the dependency graph and the directed minimum-spanning tree, with directions towards the cluster-head. Asymptotic energy analyses of these schemes are done assuming random placement of nodes over a large region according to Poisson or the uniform distribution.

Index Terms

Detection and estimation, Gauss-Markov random fields, routing, data fusion.

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