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Interval Algebra - an Effective Means of Scheduling Surveillance Radar Networks

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Abstract

Interval Algebra provides an effective means to schedule surveillance radar networks, as it is a temporal ordering constraint language. Thus it provides a solution to a part of resource management, which is included in the revised Data Fusion Information Group model of information fusion. In this paper, the use of Interval Algebra to schedule mechanically steered radars to make multistatic measurements for selected targets of importance is shown. Interval Algebra provides a framework for incorporating a richer set of requirements, without requiring modifications to the underlying algorithms. The performance of Interval Algebra was compared to that of the Greedy Randomised Adaptive Search Procedure and the applicability of Interval Algebra to nimble scheduling was investigated using Monte-Carlo simulations of a binary radar system. The comparison was done in terms of actual performance as well as in terms of computation time required. The performance of the algorithms was quantified by keeping track of the number of targets that could be measured simultaneously. It was found that nimble scheduling is important where the targets are moving fast enough to rapidly change the recognised surveillance picture during a scan. Two novel approaches for implementing Interval Algebra for scheduling surveillance radars are presented. It was found that adding targets on the fly and improving performance by incrementally growing the network is more efficient than pre-creating the full network. The second approach stemmed from constraint ordering. It was found that for simple constraint sets, the Interval Algebra relationship matrix reduces to a single vector of interval sets. The simulations revealed that an Interval Algebra algorithm that utilises both approaches can perform as well as the Greedy Randomised Adaptive Search Procedure with similar processing time requirements. Finally, it was found that nimble scheduling is not required for surveillance radar networks where ballistic and supersonic targets can be ignored. Nevertheless, Interval Algebra can easily be used to perform nimble scheduling with little modification and may be useful in scheduling the scans of multifunction radars.