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Probabilistic Approach of Dealing with Uncertainties in Distributed Constraint Optimization Problems and Situation Awareness for Multi-agent Systems

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Abstract : In this paper, we describe how Bayesian inferential reasoning will contributes in obtaining a well-satisfied prediction for Distributed Constraint Optimization Problems (DCOPs) with uncertainties. We also demonstrate how DCOPs could be merged to multi-agent knowledge understand and prediction (i.e. Situation Awareness). The DCOPs functions were merged with Bayesian Belief Network (BBN) in the form of situation, awareness, and utility nodes. We describe how the uncertainties can be represented to the BBN and make an effective prediction using the expectation-maximization algorithm or conjugate gradient descent algorithm. The idea of variable prediction using Bayesian inference may reduce the number of variables in agents’ sampling domain and also allow missing variables estimations. Experiment results proved that the BBN perform compelling predictions with samples containing uncertainties than the perfect samples. That is, Bayesian inference can help in handling uncertainties and dynamism of DCOPs, which is the current issue in the DCOPs community. We show how Bayesian inference could be formalized with Distributed Situation Awareness (DSA) using uncertain and missing agents’ data. The whole framework was tested on multi-UAV mission for forest fire searching. Future work focuses on augmenting existing architecture to deal with dynamic DCOPs algorithms and multi-agent information merging.

Keywords : DCOP, multi-agent reasoning, Bayesian reasoning, swarm intelligence
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