Merging of Fragmental Probabilistic Information for a Flatly Structured Cooperation

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Inherent complexity of dynamic decision making (DM) under uncertainty, that precludes implementation of formally optimal strategies, has been primary motivation for the reported research[2]. Distributed DM seems to be only way out of this "curse of dimensionality". A systematic and fully scalable solution has to cope with a flatly organized structures. Otherwise, central decision makers and communication channels to them are either overloaded or information loss is too high.

A cooperation within flat cooperation structures has to rely on combination of fragmental, not fully compatible, probabilistic information pieces. This is a common problem in many application domains. It has been addressed repeatedly, for instance, in connection with probabilistic expert systems [2], knowledge elicitation, [6], cooperation of participants, [1, 5], etc. None of the existing methodologies seems to be complete and automatic enough to serve to the considered purpose.

Flat structures are common in large societal groups: each member of the group has its aims, restricted perceiving, modelling, acting and evaluating abilities. Consequently, he (she/it) interacts with a relatively small number of "neighbors" and modifies his DM elements in inherently selfish way. This fully scalable cooperation model is worth imitation.

This contribution describes a promising methodology [4] based on this model. It formalizes this cooperation structure assuming that the group is formed by Bayesian decision makers who use so called fully probabilistic design of the optimal decision strategy [3]. The group members are supposed to be willing to cooperate with neighbors by providing them probabilistic distributions they use for their DM. At present research stage, interaction and communication structure are assumed to be given. Thus, the group DM is determined by specifying how the offered non-standard (probabilistic) fragmental information pieces is to be exploited.

The exploitation problem is formulated and solved in a strictly Bayesian way. The group member: (i) takes the offered distributions as measured data; (ii) estimates an unknown global distribution describing the cooperating neighbors; (iii) projects this estimate on the domains of interest to the respective neighbors; (iv) approximates each projected distribution by the distribution, which has the form understandable to the decision maker.

The proposed methodology is of an independent interest since it can be used for model and aim elicitation.

References

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