Fully Probabilistic Design: Promises and Prospects

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The Fully Probabilistic Design (FPD) suggests a probabilistic description of the closed control loop behaviour as well as *desired* closed-loop behaviour. The optimal control strategy is selected as the minimiser of the Kullback-Leibler divergence of these distributions. The approach yields: (i) an explicit minimiser with the evaluation reduced to a conceptually feasible solution of integral equations; (ii) a randomised optimal strategy; (iii) a proper subset of FPDs formed via standard Bayesian designs; (iv) uncertain knowledge, multiple control goals, and optimisation constrains be expressed in the common probabilistic language. It implies: (i) an easier approximation of the dynamic programming counterpart; (ii) the optimal strategy is naturally explorative; (iii) the goals-expressing ideal distribution can be, even recursively, tailored to the observed closed-loop behavior; (iv) an opportunity to automatically harmonise knowledge and goals within a flat cooperation structure of *decentralised* task.

An importance of the last point has been confirmed by a huge amount of societal/industrial problems that cannot be governed in a centralised way. The anticipated decentralised solution based on the FPD may concern either a number of interacting, locally independent elements, which have their local goals, but have to collaborate to reach a common group goal (e.g. cooperative robots, multi-agent systems, etc.); or a set of independent elements with own goals that need to coordinate their activities (e.g. transportation).
The talk will recall the basic properties of FPD and discusses the promises of an exploitation of the FPD potential.

References

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