Differentially Private Formation Control: Privacy and Network Co-Design

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Abstract: As multi-agent systems proliferate, there is increasing demand for coordination protocols that protect agents' sensitive information while allowing them to collaborate. To help address this need, I will present a distributed differentially private formation control framework. Agents' state trajectories are protected using differential privacy, which is a statistical notion of privacy that protects data by adding noise to it. I will provide a private formation control implementation and analyze tradeoffs between privacy level, system performance, and connectedness of the network's communication topology. These trade-offs will be used to formulate a co-design optimization problem to select the optimal communication topology and privacy parameters for a network running differentially private formation control. This problem is proven to be convex, and thus it can be solved efficiently with standard computational tools. I will present methods to calculate a closed form solution for the steady-state error covariance matrix for private formations and analyze how the lack of a central aggregator affects performance of differentially private formation control. Simulation results will be presented to illustrate the scalability of our proposed privacy/network co-design problem to large multiagent networks.

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