

## Fast and Flexible Multi-Agent Decision-Making

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### Abstract:

A multi-agent system should be capable of fast and flexible decision-making if it is to successfully manage the uncertainty, variability, and dynamic change encountered when operating in the real world. Decision-making is fast if it breaks indecision as quickly as indecision becomes costly. This requires fast divergence away from indecision in addition to fast convergence to a decision. Decision-making is flexible if it adapts to signals important to successful operations, even if they are weak or rare. This requires tunable sensitivity to input for modulating regimes in which the system is ultra-sensitive and in which the system is robust. Nonlinearity and feedback in the multi-agent decision-making dynamics are necessary to meet these requirements.

I will present theoretical principles, analytical results, and applications of a general model of decentralized, multi-agent, and multi-option, nonlinear opinion dynamics that enables fast and flexible decision-making. I will explain how the critical features of fast and flexible multi-agent decision-making depend on nonlinearity, feedback, and the structure of the inter-agent communication network and a belief system network. And I will show how the theory and results provide a principled and systematic means for designing and analyzing multi-agent decision-making in systems ranging from multi-robot teams to social networks.