Policy optimization for dynamic spatiotemporal systems

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Interventions performed in space and time subject to resource constraints are common in ecology and many other fields. For example, we consider intervention strategies to slow the spread of white nose syndrome (WNS) in hibernating bats. WNS has dire consequences for both the bat population and agriculture production in affected areas. A policy is required to determine where and when interventions such as cave closings should be implemented. Finding an optimal policy in this case is challenging because data are sparse, disease dynamics are complex, and the state and action spaces are extremely high dimensional. We propose a general framework for policy optimization in dynamic spatiotemporal systems. The key features of our approach are that it ensures an interpretable policy, exploits scientific knowledge of the disease, adapts to changes in the system, properly accounts for many sources of uncertainty, and can be applied to high-dimensional problems. In our analysis of WNS, we show that the proposed approach can lead to substantial improvements over competing methods.

Keywords: ecological data; decision making; policy search; spatial statistics.