Consensus Bayesian Models for Analysis of Distributed Spatio-Temporal Processes: Human Affect, Crowds, and Beyond

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Abstract

Statistical methods rely on compact summaries of large amounts of data to address problems that may be difficult to tackle with geometric reasoning or physical modeling alone. A basic premise in those settings is that of one central model (however complex it may be) is estimated from a body of data. However, frequently the problems one seeks to address have distributed nature: networks of cameras (placed e.g., on mobile phones) may observe an event distributed in space and time. Moreover, such sensors are frequently carried and controlled by human users. The sensors offer a record of events around the user, affected or unaffected by the user herself, her affective state as well as the social context. Therefore, we are faced with two critical questions: 1) Is it possible to learn a set of decentralized probabilistic models, each dedicated to one (or a small cluster of) sensors, and yet guarantee that those models will agree in their view of the world, making them effectively equivalent to one centralized model? 2) How do we take into account the affective state of the user in those models and whether and how one can efficiently estimate it from sensory (mostly visual) data. In this talk I will answer those two questions by reviewing the work in distributed Bayesian learning for large data and human affect modeling in my group. This will be demonstrated on problems such as the distributed 3D structure-from-motion, distributed matrix completion, human emotion and pain intensity modeling, and others.