Information-Driven Inference under Resource Constraints

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In many inference problems resource constraints preclude the utilization of all available measurements. Consequently, active approaches seek to choose the subset of measurements which maximize the expected information gain for an underlying inference task. By way of example, state estimation in distributed sensor networks presents a fundamental trade-off between the value of information contained in a distributed set of measurements versus the resources expended to acquire them, fuse them into a model of uncertainty, and then transmit the resulting model. A variety of challenges arise in such contexts including developing models for quantify the information content of a sensor or suite of sensors and developing tractable algorithms for sensor planning over long time horizons while incorporating resource constraints. The former is particularly challenging for video sensors owing to the complex measurement model while the latter suffers from exponential complexity. I will discuss recent efforts on both fronts where signals collected under a common exctitation can be used to estimate bounds on information while approximate dynamic programming methods can be used to reduce exponential complexity to polynomial complexity.