USU Data Science & Statistics Seminar

Robust Statistical Procedures for Finding Structure in Noisy Data

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Abstract: This talk addresses two topics related to robust statistical procedures for analyzing noisy, high-dimensional data: (I) path-based spectral clustering and (II) robust multi-reference alignment (MRA). Both methods must overcome a large ambient dimension and lots of noise to extract the relevant low dimensional data structure in a computationally efficient way. In (I), the goal is to partition the data into meaningful groups, and this is achieved by a novel approach which combines a data driven path metric with graph-based clustering. Using a data driven metric allows for strong theoretical guarantees, fast algorithms, and a flexible framework for balancing density and geometry considerations. Regarding (II), recent advances in applications such as cryo-electron microscopy have sparked increased interest in the mathematical analysis of multi-reference alignment (MRA) problems, where the goal is to recover a hidden signal from many noisy observations. The simplest model considers observations of a 1-d hidden signal which have been randomly translated and corrupted by high additive noise. We generalize this classic problem by incorporating random dilations into the data model, and explore multiple approaches to its solution based on translation invariant representations and nonlinear, data-driven unbiasing procedures.

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