



Contribution ID: 138

Type: **not specified**

## Maximum Covariance Unfolding Regression: A Novel Covariate-Based Manifold Learning Approach for Point Cloud Data

*Tuesday, 12 September 2023 11:35 (30 minutes)*

Point cloud data are widely used in manufacturing applications for process inspection, modeling, monitoring and optimization. The state-of-art tensor regression techniques have effectively been used for analysis of structured point cloud data, where the measurements on a uniform grid can be formed into a tensor. However, these techniques are not capable of handling unstructured point cloud data that are often in the form of manifolds. In this paper, we propose a nonlinear dimension reduction approach named Maximum Covariance Unfolding Regression that is able to learn the low-dimensional (LD) manifold of point clouds with the highest correlation with explanatory covariates. This LD manifold is then used for regression modeling and process optimization based on process variables. The performance of the proposed method is subsequently evaluated and compared with benchmark methods through simulations and a case study of steel bracket manufacturing.

### Keywords

High-dimensional Data; Point Clouds; Process Modeling and Optimization; Manifold Learning; Maximum Covariance Unfolding

### Classification

Both methodology and application

**Primary authors:** PAYNABAR, Kamran (School of Industrial and Systems Engineering); Dr WANG, Qian (Wells Fargo)

**Presenter:** PAYNABAR, Kamran (School of Industrial and Systems Engineering)

**Session Classification:** INVITED QSR-INFORMS

**Track Classification:** Other/special session/invited session