

DEFENSE OF THE DOCTORAL DISSERTATION

DEPARTMENT OF MATHEMATICS

“Some Generalizations in Nonparametric Function Estimation for Temporal Spatial Multidimensional Data”



Carlos Madrid Padilla

Monday, April 1, 2024

Time: 3:30 PM

Location: 129 Hayes-Healy Bldg

Examination Committee:

Daren Wang - ACMS, Advisor

Sam Evens

Jiahong Wu

Xiufan Yu - ACMS

Lizhen Lin – Univ. of Maryland



Abstract:

We focus on the estimation of a non-parametric regression function in the presence of data with temporal-spatial dependencies. In such a context, we study Trend Filtering, a nonparametric estimator. To the best of our knowledge, this estimator has not previously been examined in a similar context. For univariate settings, the signals we consider are assumed to have a k th weak derivative with bounded total variation, allowing for a general degree of smoothness. In the multivariate setting, we study a variant of the k -Nearest Neighbor fused lasso estimator. For this case, the function is required to have bounded variation and satisfy a property that extends a piecewise Lipschitz continuity criterion, or the function is assumed to be piecewise Lipschitz. We develop an ADMM algorithm for practical computation. By aligning with lower bounds, the minimax optimality of our univariate and multivariate estimators is shown. A unique phase transition phenomenon, previously unprecedented in Trend Filtering studies, emerges through our analysis. Both simulation studies and real data applications underscore the superior performance of our method when compared with established techniques in the existing literature.