

## Chapter 15<sup>1</sup>

# A Survey of Manifold-Based Learning Methods

Xiaoming Huo<sup>1</sup>, Xuelei (Sherry) Ni<sup>2</sup>, and Andrew K. Smith<sup>1</sup>

<sup>1</sup>School of Industrial Engineering, Georgia Institute of Technology, Atlanta, GA, U.S.A.

Email: [xiaoming@isye.gatech.edu](mailto:xiaoming@isye.gatech.edu)

<sup>2</sup>Department of Mathematics and Statistics, Kennesaw State University, GA, U.S.A.

Email: [xni2@kennesaw.edu](mailto:xni2@kennesaw.edu)

**Abstract:** We review the ideas, algorithms, and numerical performance of manifold-based machine learning and dimension reduction methods. The representative methods include locally linear embedding (LLE), ISOMAP, Laplacian eigenmaps, Hessian eigenmaps, local tangent space alignment (LTSA), and charting. We describe the insights from these developments, as well as new opportunities for both researchers and practitioners. Potential applications in image and sensor data are illustrated. This chapter is based on an invited survey presentation that was delivered by Huo at the 2004 INFORMS Annual Meeting, which was held in Denver, CO, U.S.A.

**Key Words:** Manifold, Statistical learning, Nonparametric methods, Dimension reduction.

---

<sup>1</sup> Liao, T.W. and E. Triantaphyllou, (Eds.), **Recent Advances in Data Mining of Enterprise Data**, *World Scientific*, Singapore, pp. 691-745, 2007.