Matrix, Geometry, and Network: Connecting Numerical Thinking and Combinatorial Thinking in Algorithm Design

Shang-Hua Teng
University of Southern California

Computing has the magical touch in connecting seemingly unrelated research fields or even disciplines. The initial connection was usually made by the visionaries of its generation through the lens of a few basic problems. But once a connection was made, computing as a scientific discipline would grow rapidly.

In this talk, I will survey some of my own joint research during the last 25 years that have been inspired by two such pioneering results: One is the Nested Dissection, which applies a combinatorial technique to solve a numerical problem. The other is Spectral Partitioning, which applies a numerical technique to solve a combinatorial problem. I will loosely divided my talk into four parts

  I. Geometric Graph Partitioning
 II. Spectral Graph Theory,
III. Smoothed Analysis
IV. The Laplacian Paradigm

The central theme of these studies is to connect Numerical Thinking and Combinatorial Thinking in Algorithm Design.

** This talk is based on joint work with Dan Spielman, Gary Miller, Steve Vavasis, William Thurston, Jon Kelner, James Lee, Greg Price, Heiko Roglin, Paul Christiano, and Aleksander Madry