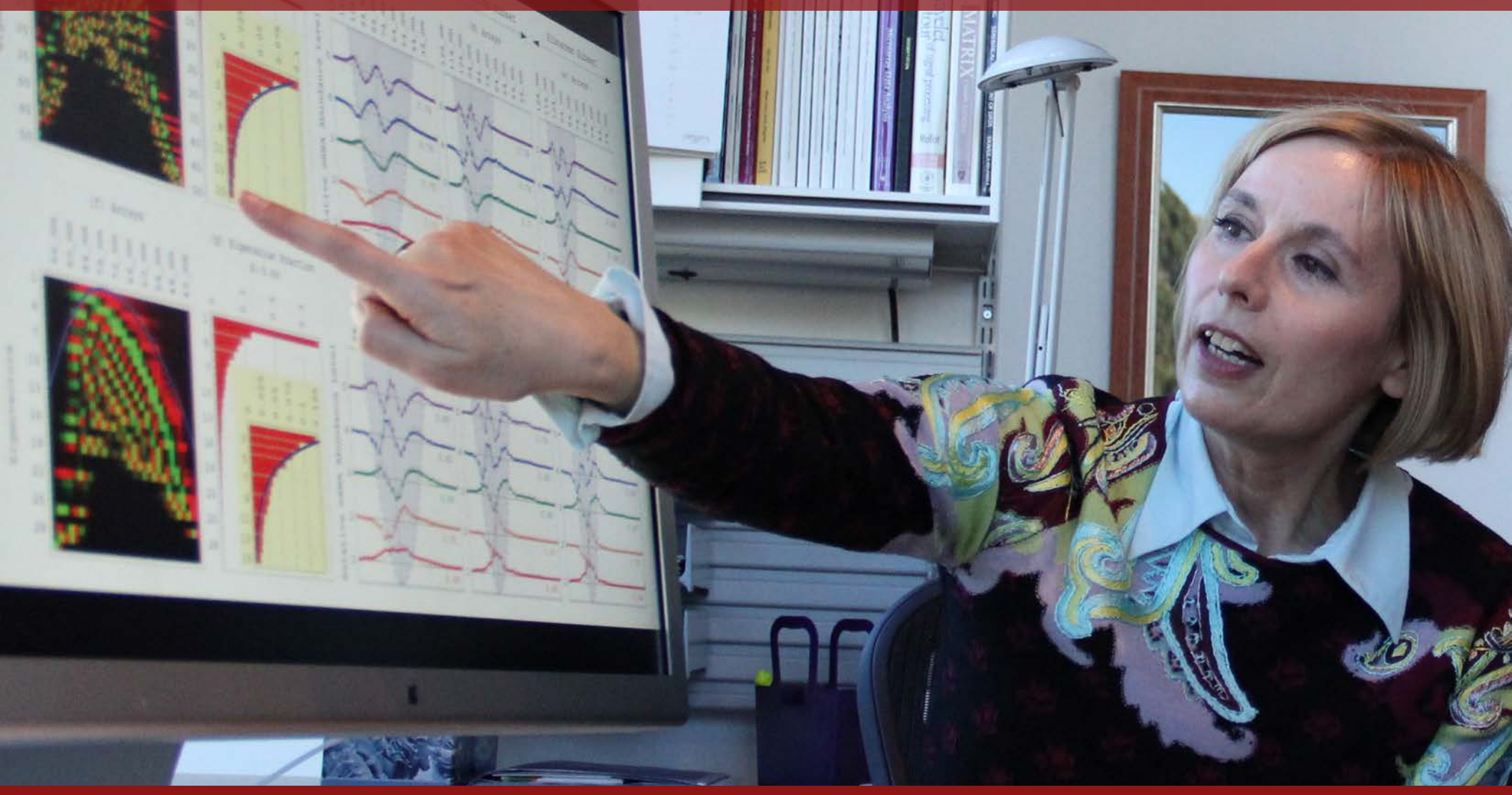
Institute for Computational and Mathematical Engineering, Stanford University

Linear Algebra and Optimization Seminar

January 16, 2020, 4:30pm at 473 Via Ortega, Y2E2 101

Orly Alter

USTAR Associate Professor at the Scientific Computing and Imaging Institute and the Huntsman Cancer Institute, University of Utah and CTO and Co-Founder, Eigengene



Multi-Tensor Decompositions for Personalized Cancer Diagnostics, Prognostics, and Therapeutics

I will describe the development of novel, multi-tensor generalizations of the singular value decomposition, and their use in the comparisons of, e.g., brain, lung, ovarian, and uterine cancer and normal genomes. They uncover patterns of DNA copy-number alterations that predict survival and response to treatment, statistically better than, and independent of, the best indicators in clinical use and existing laboratory tests. I will also describe a recent retrospective clinical trial that validates the brain cancer pattern. Recurring alterations have been recognized as a hallmark of cancer for over a century, and observed in these cancers' genomes for decades; however, copy-number subtypes predictive of patients' outcomes were not identified before. The data had been publicly available, but the patterns remained unknown until the data were modeled by using the multi-tensor decompositions. I will conclude that the decompositions underlie a mathematically universal description of the genotype-phenotype relationships in cancer that other machine learning methods miss.

Orly Alter is a Utah Science, Technology, and Research (USTAR) associate professor of bioengineering and human genetics at the Scientific Computing and Imaging Institute and the Huntsman Cancer Institute at the University of Utah, and the principal investigator of a National Cancer Institute (NCI) Physical Sciences in Oncology U01 project grant. Inventor of the "eigengene," she pioneered the matrix and tensor modeling of large-scale molecular biological data, which, as she demonstrated, can correctly predict previously unknown physical, cellular, and evolutionary mechanisms. Alter received her Ph.D. in applied physics at Stanford University, and her B.Sc. *magna cum laude* in physics at Tel Aviv University. Her Ph.D. thesis on "Quantum Measurement of a Single System," which was published by Wiley-Interscience as a book, is recognized today as crucial to the field of gravitational wave detection.