*Workshop*
*on*

# Future Directions in Tensor-Based Computation and Modeling[1]

*National Science Foundation*
*Arlington, Virginia*
*February 20-21, 2009*

## *Program*

**Organizer:**
Charles Van Loan (Department of Computer Science, Cornell University)

**NSF Sponsors:**
Lenore Mullin (Division of Computing and Communications Foundations, CISE)
Frank Olken (Division of Computing and Communications Foundations, CISE)

[1] Award number 0908059

# Friday, February 20

8:15-9:00 Breakfast
Room 120

9:00-9:30 Opening
Room 110

*Welcome*
**Lenore Mullin** (NSF) , **Frank Olken** (NSF)

*Workshop Goals*
**Charles Van Loan** (Cornell University)

*Three Right Directions and Three Wrong Directions for Tensor Research*
**Michael W. Mahoney** (Stanford)

9:30-12:30 Tensor Methods and Modeling: Why the Proliferation?
Room 110

*Alternating Tensors and Rank Learning*
**Lek-Heng Lim** (University of California, Berkeley)

*Mining Graphs and Tensors*
**Christos Faloutsos** (Carnegie Melon University)

*Mathematical Modeling of DNA Microarray Data: Discovery of Biological Mechanisms with Tensor Decompositions, and Definitions of Novel Tensor Decompositions from Biological Applications*
**Orly Alter** (University of Texas, Austin)

10:45-11:15 Coffee Break
Room 120

*Tensor Clustering and Error Bounds*
**Chris Ding** (University of Texas, Arlington)

*Unusual Tensor Decompositions for Informatics Applications*
**Brett W. Bader**, (Sandia National Laboratory)

*Challenges in Tensor Mining*
**Evrim Acar Ataman** (Sandia National Laboratory)

12:30-1:30 Lunch
Room 120

## 1:30-3:30 Software and Language: How Do We Build an Infrastructure that Supports High-Performance, Tensor-Based Computation?

Room 110

*Domain-Specific Abstractions for High-Productivity, High-Performance Scientific Computing*
**J. (Ram) Ramanujam** (Louisiana State University) and **P. (Saday) Sadayappan** (Ohio State University)

*Communication Avoiding and Tiled Algorithm for "2D" Linear Algebra.*
**Julien Langou** (University of Colorado, Denver)

*Software Challenges in Computational Science*
**Anthony Kennedy** (Edinburgh University)

*A Mathematics of Arrays (MoA}, Psi Calculus and the Composition of Tensor and Array Operations*
**Lenore Mullin** (NSF) and **James E. Raynolds** (SUNY, Albany)

*Tensor Computation on High Performance Machines*
**Manal Helal** (University of New South Wales) and **Lenore Mullin** (NSF)

3:30-4:00 Coffee Break
Room 120

## 4:00-5:30 The Curse of Dimensionality: A Grand Challenge?

Room 110

*Computing with Sums of Separable Functions, with Applications in Quantum Mechanics*
**Martin Mohlenkamp** (Ohio University)

*Nonlinear Approximations, Multi-linear Tools and Algorithms with Finite but Arbitrary Accuracy.*
**Gregory Beylkin,** (University of Colorado, Boulder)

*Multi-Length Scale Matrix Computations and Applications in Quantum Mechanical Simulations.*
**Zhaojun Bai** (University of California, Davis)

*From Math to Peta-app: Challenges in Practical Computation with Tensor-Based Algorithms.*
**Robert J. Harrison** (Oak Ridge National Laboratory)

# Saturday, February 21

8:15-9:00 Breakfast
Room 120

## 9:00-10:45 Multilinear Optimization: More Nonlinear than Linear?
Room 110

*Optimization Approaches for Solving Tensor Decompositions Models and Tensor Eigenvalue Problems*
**Tamara G. Kolda** (Sandia National Laboratories)

*Newton-Type Methods for Non-negative Tensor Approximation*
**Inderjit Dhillon** (University of Texas, Austin)

*Toward Faster Nonnegative Tensor Factorization: A New Activeset type Algorithm and Comparisons*
**Haesun Park** (Georgia Institute of Technology)

*Some Applications of Nonnegative Tensor Factorizations to Mining Hyperspectral and Global Climate Data*
**Robert Plemmons** (Wake Forest University)

10:45-11:15 Coffee Break
Room 120

## 11:15-12:30 Tensor-Based Signal Processing and Statistics: Where To and Why?
Room 110

*Cumulant Signal Processing, Tensors, and Some Recurring Problems*
**Phillip Regalia** (Catholic University of America)

*An Introduction to Tensor-Based Independent Component Analysis*
**Lieven De Lathauwer** (K.U.Leuven)

*Algebraic Models for Multilinear Dependence*
**Jason Morton** (Stanford University)

12:30-1:30 Lunch
Room 120

1:30-2:45 Tensor Problems: What Makes Them Hard?
Room 110

*Developing Tensor Operations with an Underlying Group Structure*
**Carla Martin** (James Madison University)

*Results and Problems for 3-tensors*
**Shmuel Friedland** (University of Illinois, Chicago)

*Tensor Decompositions from a Theoretical Computer Science Perspective*
**Petros Drineas** (Rensselaer Polytechnic Institute)

2:45-3:15 Coffee Break
Room 120

3:15-4:15 Numerical Linear Algebra: What Is Its Message?
Room 375

*Krylov Methods for Tensors I*
**Lars Elden** (Linkoping University)

*Krylov Methods for Tensors II*
**Berkant Savas** (Linkoping University)

*Numerical Linear Algebra Issues Underlying a Tensor Network Computation*
**Charles Van Loan** (Cornell University)

4:15-4:30 Break
Room 375

4:30-5:30 Closing Discussion
Room 375

## Sunday, February 22

9:00-11:00 Workshop Report Writing Session
Location TBA