



# THE UNIVERSITY OF CHICAGO

Departments of Computer Science, Mathematics, and Statistics  
SCIENTIFIC AND STATISTICAL COMPUTING SEMINAR

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## **New Tensor Decompositions in Numerical Analysis and Data Processing**

**Thursday, October 11, 2012 at 3:00 PM**  
112 Stevanovich Center, 5727 S. University Avenue

### **ABSTRACT**

Classical tensor decompositions (CP, Tucker) are important as data models but not good enough as a base for fast tensor algebra algorithms. Most relevant tensor decompositions for this purpose are TT (Tensor Train) and HT (Hierarchical Tucker), both are the results of one and same scheme for the reduction of dimensionality. These decompositions are frequently applied to tensors after some, often ultimate, quantization of the original dimensions. This maximizes the number of modes and makes the number of counts at each mode minimal possible, e.g. 2. We consider how multilevel matrices become tensor trains with the use of the Kronecker-product operation.

Then we show how new wavelet transforms arise in the construction of tensor trains when forcing the TT ranks be limited. We also discuss some examples and perspectives for applications.

In the end, we present an ambitious research goal of design of fast tabulation procedures using a new interpolation instrument based a TT generalization of the skeleton (dyadic) decomposition from matrices to tensors.

### **REFERENCES**

1. I. Oseledets, E. Tyrtshnikov, TT-cross approximation for multidimensional arrays, *Linear Algebra Appl.*, 432 (2010), pp. 70-88.
2. I. Oseledets, E. Tyrtshnikov, Algebraic wavelet transform via quantics tensor train decomposition, *SIAM J. Sci. Comp.*, vol. 31, no. 3 (2011), pp. 1315-1328.
3. I. Oseledets, E. Tyrtshnikov, N. Zamarashkin, Tensor-train ranks for matrices and their inverses, *Comput. Meth. Appl. Math.*, Vol. 11, No. 3 (2011), pp. 375-384.

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