Improving the Bounds of Tensor Ranks with Sparse Optimization

Taehyeong Kim[1,2], Jeong-Hoon Ju[2], and Yeongrak Kim[2]

[1]*Speaker*
[2]*Pusan National University*

April 21, 2023

The tensor rank is the minimal number of summands when we express a given tensor as a sum of decomposable tensors In this study, we present a tensor rank upper bound improvement derived from a least absolute shrinkage and selection operator (LASSO) technique based on sparse identification of nonlinear dynamics (SINDy) and sparse dictionary learning (SDL). We propose a new method for constructing candidates using a sufficiently large number of random matrices and then solving a sparse optimization problem to find useful candidates for the formula of the desired objective. We show that this method can be used to find Strassen's 2×2 matrix multiplication formula and Derksen's 3×3 determinant formula if there are enough different kinds of candidates. In particular, we propose a new determinant formula of 4×4 matrices which dramatically improves the upper bound of $\det_4$.