Randomized Algorithms for Rounding the Tensor Train Format

Grey Ballard Paul Cazeaux Eric Hallman Agnieszka Miedlar

Mirjeta Pasha Tim Reid Arvind Saibaba
Hussam Al Daas

Rutherford Appleton Laboratory, STFC, Harwell Campus, Oxfordshire

The Tensor Train (TT) format is a highly compact low-rank representation for high-dimensional tensors. TT is useful in particular in representing approximations to the solution of certain types of parametrized partial differential equations. The fundamental operation used to maintain feasible memory and computational time is called rounding, which truncates the internal ranks of a tensor already in TT format. We propose several randomized algorithms for this task that are generalizations of randomized low-rank matrix approximation algorithms and provide significant reduction in computation compared to deterministic TT rounding algorithms. Randomization is particularly effective in the case of rounding a sum of TT tensors, which is the bottleneck computation in the adaptation of GMRES to vectors in TT format. In this talk, we will present the randomized algorithms and compare their empirical accuracy and computational time with deterministic alternatives.