Low rank tensor approximation—Krylov-type methods and perturbation theory

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In this talk we will consider the low multilinear rank approximation of a given third order tensor. In the first part of the talk we will present a few generalizations of matrix Krylov methods to tensors. The objective is to obtain a rank-(p, q, r) approximation of a given l x m x n tensor A. The problem can be viewed as finding low dimensional signal subspaces associated to the different modes of the tensor. Krylov methods, similar to the matrix case, are particularly well suited for problems involving large and sparse tensors or for tensors that allow efficient multilinear tensor-times-vector multiplications. For a few special cases we will prove that our methods capture the true signal subspaces associated to the tensor within certain number of steps in the algorithm. We will present experimental results on real world data that confirm the usefulness of the proposed methods for the given objective.

In the second part of the talk we will discuss sensitivity of a low rank tensor approximation due to perturbations. As the low rank tensor approximation problem is a highly non-linear we will consider solutions at points of local optimum of the objective function. We will figuratively describe the first and second order conditions of optimality and compare them with the matrix case. Further, for the best rank-k matrix approximation, given by the truncated singular value decomposition (SVD), it is well known that the sensitivity of the left and right singular vectors is bounded in terms of the gap between the k'th and (k+1)'th singular values. We will see what this gap generalizes to in the case for low rank tensor approximations. We will use specific examples to illustrate the concepts of the presentation.