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On minimal ranks and the approximate block-term tensor decomposition

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The block-term tensor decomposition (BTD) is a generalization of the tensor rank (or canonical polyadic) decomposition which is well suited for certain source separation problems. In this talk, I will discuss the existence of a best approximate block-term tensor decomposition (BTD) consisting of a sum of low-rank matrix-vector tensor products. This investigation is motivated by the fact that a tensor might not admit an exact BTD with a given structure (number of blocks and their ranks).
After a brief introduction, we will proceed by exploring the isomorphism between third-order tensors and matrix polynomials. To every matrix polynomial one can associate a sequence of minimal ranks, which is unique up to permutation and invariant under the action of the general linear (or tensor equivalence) group. This notion is a key ingredient of our problem, since it induces a natural hierarchy of sets of third-order tensors corresponding to different choices of ranks for the blocks of the BTD.
In the particular case of matrix pencils, I will explain how the minimal ranks of a pencil can be directly determined from its Kronecker canonical form. By relying on this result, one can show that no real pencil of dimensions 2k x 2k having full minimal ranks admits a best approximation on the set of real pencils whose minimal ranks are bounded by 2k-1. From the tensor viewpoint, this means that there exist third-order tensors which do not have a best approximation on a certain set of two-block BTDs. These tensors form a non-empty open subset of the space of 2k x 2k x 2 tensors, which is therefore of positive volume. I shall sketch the proof of this result and then discuss some possible extensions of this work and open problems.

Orateur: DE MORAIS GOULART, José Henrique (GIPSA-lab, CNRS, Grenoble)