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Application of the sequential matrix diagonalization algorithm to high-dimensional functional MRI data. (English) [Zbl 07225396](#)

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Summary: This paper introduces an adaptation of the sequential matrix diagonalization (SMD) method to high-dimensional functional magnetic resonance imaging (fMRI) data. SMD is currently the most efficient statistical method to perform polynomial eigenvalue decomposition. Unfortunately, with current implementations based on dense polynomial matrices, the algorithmic complexity of SMD is intractable and it cannot be applied as such to high-dimensional problems. However, for certain applications, these polynomial matrices are mostly filled with null values and we have consequently developed an efficient implementation of SMD based on a GPU-parallel representation of sparse polynomial matrices. We then apply our “sparse SMD” to fMRI data, i.e. the temporal evolution of a large grid of voxels (as many as 29,328 voxels). Because of the energy compaction property of SMD, practically all the information is concentrated by SMD on the first polynomial principal component. Brain regions that are activated over time are thus reconstructed with great fidelity through analysis-synthesis based on the first principal component only, itself in the form of a sequence of polynomial parameters.

MSC:

65C60 Computational problems in statistics (MSC2010)

Keywords:

polynomial eigenvalue decomposition (PEVD); sequential matrix diagonalization (SMD); MIMO convolution; sparse polynomial matrix (SPM); functional magnetic resonance imaging (fMRI)

Software:

CUDA; FEAST; JDQR; JDQZ; MKL

Full Text: [DOI](#)

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