Independent component analysis for tensor-valued data

Joni Virta[1], **Bing Li**[2], **Klaus Nordhausen**[1] **and Hannu Oja**[1]

[1] *University of Turku, Finland, joni.virta@utu.fi, klaus.nordhausen@utu.fi, hannu.oja@utu.fi*
[2] *Pennsylvania State University, US, bing@stat.psu.edu*

Keywords: FOBI, Kronecker structure, matrix-valued data, multilinear algebra

In preprocessing high-dimensional tensor data, e.g. images or videos, a common procedure is to vectorize the observed tensors and subject the resulting vectors to one of the many methods used for independent component analysis (ICA). However, the structure of the original tensor is lost in the vectorization along with any meaningful interpretations of its modes. To provide a more suitable alternative, we propose the Tensor fourth order blind identification (TFOBI), a tensor-valued analogy of the classic Fourth order blind identification (FOBI), to be used with the semiparametric tensor independent component model. In TFOBI, instead of vectorizing, we stay in the tensor form and in a sense perform FOBI simultaneously on all the modes of the observed tensors. Furthermore, being an extension of FOBI, TFOBI shares with it its computational simplicity. Simulated and real-world examples are used to showcase the method's usefulness and superiority over the combination of vectorizing and FOBI.