**ABSTRACT**

Tensor decomposition models for multidimensional datasets have a long history in mathematics and applied sciences. While these models have recently been applied to multidimensional signal processing, they were developed independently of the theory of sparse representations and Compressed Sensing (CS). We discuss, and illustrate recent results revealing connections among the Tucker tensor decomposition model, the recovery of low-rank multidimensional signals and CS theory.

**THE TUCKER TENSOR DECOMPOSITION MODEL**

Definition: A multidimensional signal (tensor) can be approximated by the following tensor factorization known as Tucker model [1]:

\[
\mathbf{X} \approx \mathbf{X} \times_1 \mathbf{D}_1 \times_2 \mathbf{D}_2 \times \cdots \times_\mathcal{N} \mathbf{D}_\mathcal{N}
\]

\[
\mathbf{Y} \in \mathbb{R}^{(l_1 \times l_2 \times \cdots \times l_\mathcal{N} \times \cdots \times l_\mathcal{N})}
\]

\[
\mathbf{X} \in \mathbb{R}^{(l_1 \times l_2 \times \cdots \times l_\mathcal{N} \times \cdots \times l_\mathcal{N})}
\]

Core tensor Factor matrices

Multidimensional signal (tensor) Graphical representation of the Tucker model (3D case)

The Tucker tensor decomposition model is also known as the CANDECOMP/PARAFAC (CP) model. A result in this case is the Tucker rank which is defined as the minimum rank of the sub-tensor obtained by selecting a specific index in each mode. The Tucker rank of the sub-tensor in equation (1) is defined by the following expression:

\[
\mathbf{X} = \mathbf{X} \times_1 \mathbf{D}_1 \times_2 \mathbf{D}_2 \times \cdots \times_\mathcal{N} \mathbf{D}_\mathcal{N}
\]

**TENSORS AND SPARSE MODELS WITH BLOCK SPARSITY [3]**

When non-zero entries are located within a sub-tensor of the core tensor (block sparsity), the Orthogonal Matching Pursuit (OMP) strategy can be applied efficiently in terms of memory usage and complexity by exploiting the Kronecker structure of block sparsity (KBSMP) [3].

**LEARNING KRONECKER DICTIONARIES FROM A SET OF TENSOR EXAMPLES [6]**

Analysis of the application of the Kronecker Dictionary Learning Algorithm [6] to (8x8)-patches taken from “Barbara” and “Text” images. A total number of 10,000 patches were selected randomly from each of these datasets.

**REFERENCES**


