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A convex optimization based coupled non-negative matrix factorization algorithm for hyperspectral and multispectral data fusion

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Fusing a low-spatial-resolution (LSR) hyperspectral data with a high-spatial-resolution (HSR) multispectral data has been recognized as an economical approach for obtaining HSR hyperspectral data, which is important to accurate identification and classification of the underlying materials. A natural and promising fusion criterion, called coupled non-negative matrix factorization (CNMF), has been reported that can yield high quality fused data. However, the CNMF criterion amounts to an ill-posed inverse problem and hence advisable regularization can be considered for further upgrading its fusion performance. Besides the commonly used sparsity-promoting regularization, we also incorporate the well-known sum-of-squared-distances (SSD) regularizer, which serves as a convex surrogate of the volume of the simplex of materials' spectral signature vectors (i.e., endmembers), into the CNMF criterion, thereby leading to a convex formulation of the fusion problem. Then, thanks to the bi-convexity of the problem nature, we decouple it into two convex subproblems, which are then respectively solved by two carefully designed alternating direction methods of multipliers (ADMM) algorithms. Closed-form expressions for all the ADMM iterates are derived via convex optimization theories (e.g., Karush-Kuhn-Tucker conditions), and furthermore some matrix structures are employed to obtain alternative expressions with much lower computational complexities, thus suitable for practical applications. Some experimental results are provided to demonstrate the superior fusion performance of the proposed algorithm over state-of-the-art methods.

Biography

Chong Yung Chi finished his PhD in 1983 from University of Southern California. He is a Professor at the National Tsing Hua University since 1989. He has published more than 220 technical papers, including more than 80 journal papers (mostly in IEEE *Trans. Signal Processing),* and a new textbook, *"Convex Optimization for Signal Processing and Communications from Fundamentals to Applications*" CRC Press, 2017 (popularly used in an invited intensive short course many times in major universities in China, since 2010). Currently, he is a Member of the Sensor Array and Multichannel Technical Committee, IEEE Signal Processing Society.

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