# $\mathcal{F}$-Partial Least Squares and Extension: Coherent Covariation Representation for Multiview Clustering

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**Abstract**

One primary focus in Multiview Representation Learning (MRL) is to find the latent representations of individual views with maximum relevance. As a well-known approach of multivariate analysis, Partial Least Squares (PLS) becomes an appealing MRL technique due to its desirable advantages and superior applicability. However, the linear cross-covariance matrix in PLS limits its capability to model the complicated relations among different *features*. To address this problem, we propose $\mathcal{F}$-PLS, a novel approach to learn latent representations from multiple view data. The proposed method is based on a defined $\mathcal{F}$-covariation matrix that has desirable properties such as great capability in uncovering nonlinear feature relevance and being bound to be nonsingular regardless of the sample number. Moreover, we further generalize the $\mathcal{F}$-PLS to handle more than two views. An efficient algorithm is devised to solve the proposed extension and the convergence of this algorithm is proved in theory. Extensive experimental results on benchmark datasets demonstrate that our methods outperform the state-of-the-art methods in terms of clustering performance. In addition, our $\mathcal{F}$-covariation matrix can be applied to other covariance-based methods beyond multiview learning for developing new representation learning approaches.

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