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Correlated topographic analysis: estimating an ordering of correlated components

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Abstract This paper describes a novel method, which we call correlated topographic analysis (CTA), to estimate non-Gaussian components and their ordering (topography). The method is inspired by a central motivation of recent variants of independent component analysis (ICA), namely, to make use of the residual statistical dependency which ICA cannot remove. We assume that components nearby on the topographic arrangement have both linear and energy correlations, while far-away components are statistically independent. We use these dependencies to fix the ordering of the components. We start by proposing the generative model for the components. Then, we derive an approximation of the likelihood based on the model. Furthermore, since gradient methods tend to get stuck in local optima, we propose a three-step optimization method which dramatically improves topographic estimation. Using simulated data, we show that CTA estimates an ordering of the components and generalizes a previous method in terms of topography estimation. Finally, to demonstrate that CTA is widely applicable, we learn topographic representations for three kinds of real data: natural images, outputs of simulated complex cells and text data.

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