

Learning what is where from unlabeled images: joint localization and clustering of foreground objects

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Abstract “What does it mean, to see? The plain man’s answer would be, to know what is where by looking.” This famous quote by David Marr (Vision: A Computational Investigation into the Human Representation and Processing of Visual Information, Freeman, New York, 1982) sums up the holy grail of vision: discovering what is present in the world, and where it is, from unlabeled images. In this paper we tackle this challenging problem by proposing a generative model of object formation and describe an efficient algorithm to automatically learn the parameters of the model from a collection of unlabeled images. Our algorithm discovers the objects and their spatial extents by clustering together images containing similar foregrounds. Our approach simultaneously solves for the image clusters, the foreground appearance models and the spatial regions containing the objects by optimizing a single likelihood function defined over the entire image collection. We describe two methods for efficient foreground localization: the first method does not require any bottom-up image segmentation and discovers the foreground region as a contiguous rectangular bounding box. The second method expresses the foreground as a collection of super-pixels generated through a bottom-up segmentation of the image. However, unlike previous methods, objects are not assumed to be encapsulated by a single segment. Evaluation on standard benchmarks and comparison with prior methods demonstrate that our approach achieves state-of-the-art results on the problem of unsupervised foreground localization and clustering.

Keywords Unsupervised · Clustering · Foreground · Localization

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