The undirected graphical models or Markov Random Fields (MRF) are one of the more popular models used in computer vision and are the models which this work is concerned with. Models based on these methods have proven to be particularly useful in low-level vision systems and have led to state-of-the-art results for MRF-based systems. The research presented will describe a new discriminative training algorithm and how it can be implemented.

The MRF model will be trained by optimizing its parameters so that the minimum energy solution of the model is as similar as possible to the ground-truth. While previous work has relied on time-consuming iterative approximations or stochastic approximations, this work will demonstrate how implicit differentiation can be used to analytically differentiate the overall training loss with respect to the MRF parameters. This leads to an efficient, flexible learning algorithm that can be applied to a number of different models.

The effectiveness of the proposed learning method will then be demonstrated by learning the parameters of two related models applied to the task of denoising images. The experimental results will demonstrate that the proposed learning algorithm is comparable and at times better than previous training methods applied to the same tasks.

A new segmentation model will also be introduced and trained using the proposed learning method. The proposed segmentation model is based on an energy minimization framework that is novel in how it incorporates priors on the size of the segments in a way that is straightforward to implement. While other methods, such as normalized cuts, tend to produce segmentations of similar sizes, this method is able to overcome that problem and produce more realistic segmentations.

Major: Computer Science

Educational Career:
Bachelor's of Computer Science and Mathematics, BS, 2003, Morehouse College
Master's of Computer Science, MS, 2008, University of Central Florida

Committee in Charge:
Marshall Tappen, Chair, EECS
Hassan Foroosh, EECS
Niels da Vitoria Lobo, EECS
Xin Li, Mathematics

Approved for distribution by Marshall Tappen, Committee Chair, on October 2, 2012.

The public is welcome to attend.