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**Fuhua Chen\*** (fhchen66@ufl.edu), **Yunmei Chen** (yun@math.ufl.edu) and **Xiaoqing ye** (xye@ufl.edu). *Bi-direction Projected PDHG based Multi-phase Soft Segmentation.*

Soft segmentation is more flexible than hard segmentation. But the membership functions are usually sensitive to noise. In this paper, we proposed a multiphase soft segmentation model for nearly piecewise constant images based on stochastic principle, where pixel intensities are modeled as random variables with mixed Gaussian distribution. The novelty of this paper lies in three aspects. First, unlike some existing models where the mean of each phase is modeled as a constant and the variances for different phases are assumed to be the same, the mean for each phase in the Gaussian distribution in this paper is modeled as a product of a constant and a bias field, and different phases are assumed to have different variances, which makes the model more flexible. Second, we developed a bi-direction projected primal dual hybrid gradient (PDHG) algorithm for iterations of membership functions. Third, we also developed a novel algorithm for explicitly computing the projection from  $R^K$  to simplex  $\Delta_{K-1}$  for any dimension  $K$  using dual theory, which is more efficient in both coding and implementation than existing projection methods. (Received August 31, 2011)