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A multi-tier higher order conditional random field for land cover classification of multi-temporal multi-spectral landsat imagery

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Abstract:

In this paper the authors present a 2-tier higher order Conditional Random Field which is used for land cover classification. The Conditional Random Field is based on probabilistic messages being passed along a graph to compute efficiently the conditional probability for a land cover class. Conventionally the information is passed among direct spatial neighbors to improve classification accuracy. The inclusion of higher order descriptive structures in the graphs allow for more information to be pass along to further improve classification accuracy. Unfortunately this increases the computational cost beyond what is feasible to classify a large geographical area. In this work we investigate a spatially based cluster potential to improve classification accuracy while keeping the computational costs tractable. We also expand the typical 1-tier protograph used in conventional CRFs to a 2-tier graph to encapsulate the temporal dimension. This further improves the classification accuracy by modeling the seasonal variations experienced throughout the year. The conventional and higher order CRF are compared to a Random Forest on monthly composited Landsat images. These two CRFs are then compared to the same CRFs expanded to a 2-tier graph. An overall improvement between 2-4% is observed in our study area which is located near the city of Vryheid, South Africa.