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Index for Surface Coherence (ISC): A Method for Calculating Change Susceptibility

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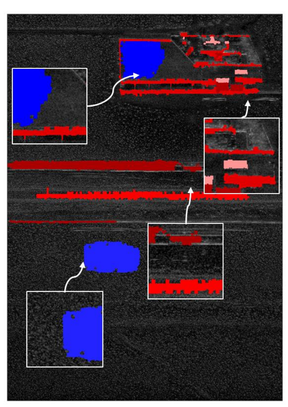
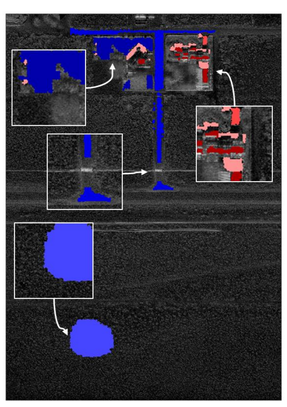
Median Products

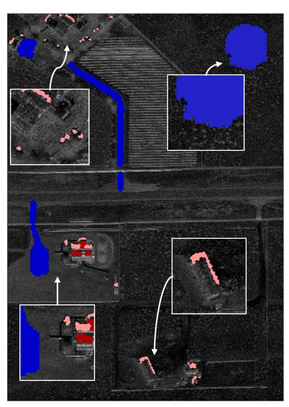
Median CCD and RCS products are used to get a more stable long term observation of the coherence and magnitude characteristics of a scene's features.

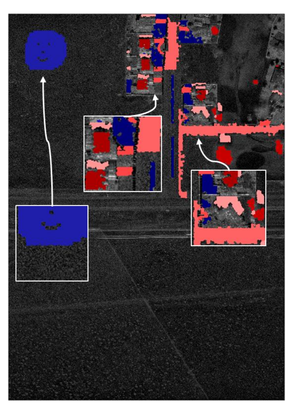
Selecting Training Regions

Various feature types across multiple patches are selected to get a diverse representation of the feature type. Regions in shades of blue are target features and regions red are non-target features.



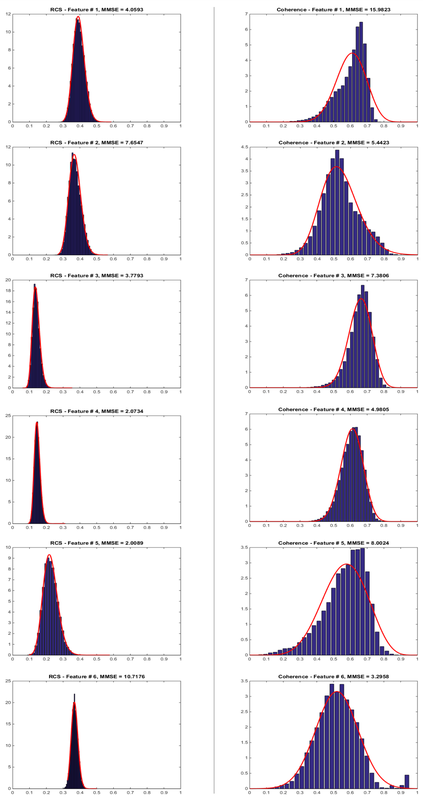






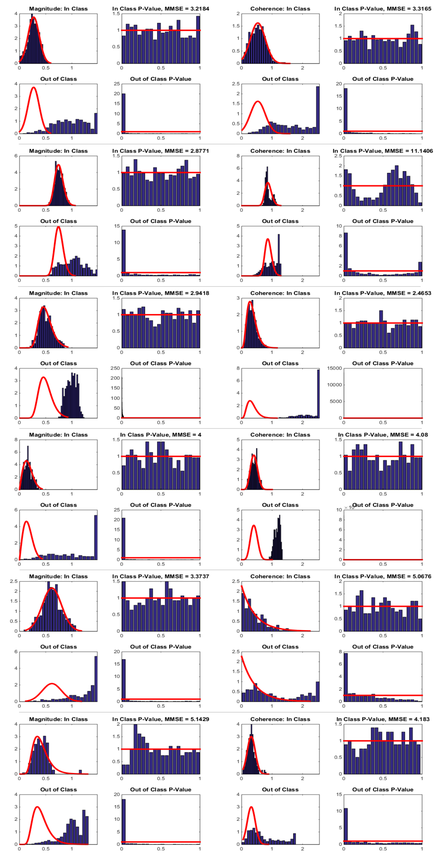
Automated Feature Curve Fitting & KL Divergence Scores

- Kullback-Leibler (KL) Divergence is used to estimate similarity to features of interest
- Training data is sampled to create a histogram representation of the feature class.
- The histograms are fit autonomously by scaling the data and using a number of different probability density function (PDF) types to find best fit in a minimum mean squared error sense.
- The scaling and PDF type are applied to each superpixel in the image.
- Divergence scores are obtained for every superpixel in the image for each feature type.



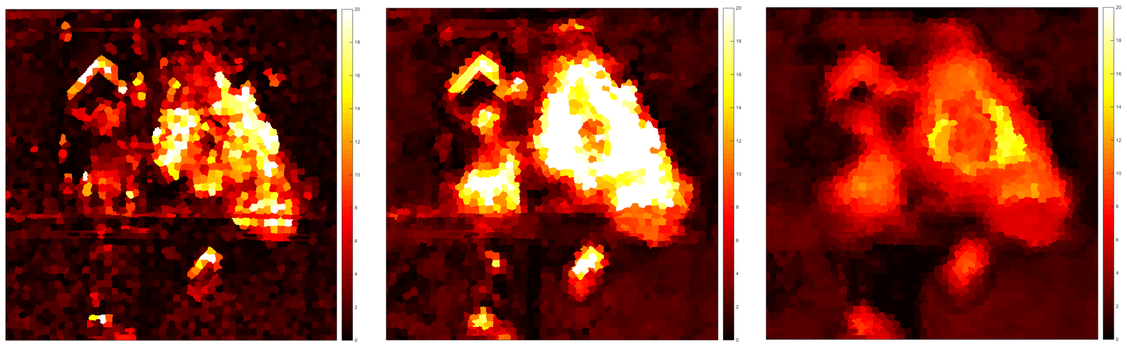
Kullback-Leibler Score Curve Fitting & Probabilistic Fusion

- The scores of the remaining training superpixels (superpixels not used for the terrain class characterization) are binned into histograms and PDF fit.
- The distributions are used in a probabilistic fusion framework to gather a P-score from its KL-score for each superpixel in the image [1][2].
- Through probabilistic fusion, P-scores allow the scene characteristics to be merged [1][2].
- The minimum of the merged scores for each superpixel are used to form a map showing the similarity to one of the target features (Ex. shown in next section)



Incorporating Nearest Neighbor Statistics

By incorporating a superpixel's neighbors (all surrounding superpixels), spatial consistency is leveraged to smooth the image [3]. However, this smoothing eliminates the defined boundaries of each region and encourages bleeding into surrounding regions. The images below show the results when incorporating no neighbors (N=0), nearest neighbors (N = 1, and both the neighbors and the neighbors' neighbors (N=2)



N = 0 N = 1 N = 2

Future Work

- Investigate the feasibility of training and forming ISC maps using CCDs and RCS images
- Conditional random fields (CRF) may help in regaining the boundaries lost in incorporating neighboring superpixel statistics
- Features of non interest could be used to bolster the areas of high scores
- Additional feature characteristics could be incorporated to give more degrees of confidence

[1] K. M. Simonson, "Probabilistic Fusion of ATR Results", Technical report SAND98-1699, Sandia National Laboratories, Albuquerque, New Mexico 87185 and Livermore, California 94550, August 1998
[2] D. R. Cox and D.V. Hinley, "Theoretical Statistics", London: Chapman and Hall, 1974
[3] B, Fulkerson et al., "Class Segmentation and Object Localization with Superpixel Neighborhoods", Dept. of Computer Science, University of California Los Angeles, Los Angeles, California, 2009