Abstract
A novel variational method using level sets that incorporate spectral angle distance in the model for automatic target detection is presented. Algorithms are presented for detecting both spatial and pixel targets. The new method is tested in tasks of unsupervised target detection in hyperspectral images with more than 100 bands, and the results are compared with a widely used region-based level sets algorithm.

TECHNICAL APPROACH
Level set is a relatively new technique that have been used widely in both denoising and images segmentation. In the case of image segmentation a surface is defined, which moves towards the boundaries of the images. The fronts, denoted by C, are represented by the zero level set C(t) = {(x, y) | (t, x, y) = 0}, as it is showed in the following figure.

ALGORITHM FOR SUPERVISED TARGET DETECTION IN
The supervised target detection algorithm is presented as a block diagram in the following figure.

\[ f(x_1, x_2) = \alpha * T + (1 - \alpha) * B + n \]

where \( \alpha \) is the fractional mixing level, \( T \) is the target signature, \( B \) is the background signature and \( n \) is the zero mean Gaussian noise. The results are shown in the following figure.

ALGORITHM FOR AUTOMATIC TARGET DETECTION
The unsupervised target detection algorithm is presented as a block diagram in the following figure.

UNSUPERVISED TARGET DETECTION RESULTS
The unsupervised target detection results are shown in the following figure.

Future Work
Shape and texture information will be added to the level set evolution equation to pull the surface in the direction of the maximum a posteriori shape and position of the target to be extracted. For this purpose a subset of target forms of different size are used to define a probability distribution over the variances of a set of training shapes which allows detecting the target of interest.

References
This work will be useful for CenSSIS Researchers and Students from S1, S2, S3 and S4 who make use of multispectral images and will result in technology transfer to the industry in the form of tools and methodologies for spectral image processing.

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