

## Edge Preserving Bi-Level Set SAR Image Filter

The mean value is a useful representation of a Gaussian population. It is not so meaningful for SAR data because of the large amplitude of the multiplicative noise and the asymmetry of its distribution. A value range could be more appropriate. Bi-level sets are regions containing only pixels whose values are inside bottom and top limits. For SAR images, statistics are often noisy and unreliable. They should be calculated over a large enough homogeneous region. The detection of homogeneous region cannot rely on statistics. A statistical decision should not be committed too early. We should wait to have enough confidence in the decision. Therefore, we should consider all possible homogeneous regions or bi-level sets.

We assume, a priori, that a homogeneous region in SAR images follows a Gamma distribution with a predefined number of looks. The quantiles of the distribution are used to find bottom and top limits that will exclude a part of the population. A list of bi-level values is constructed such as to cover the complete image value range and have a controlled overlap between them. Bi-level set is composed of one or many connected regions, i.e. region with pixels linked to each other by a path inside the region. For a given pixel, the bi-level set to use should be selected. The pixel should belong to the bi-level set and should be inside one of its connected regions. The region with the larger size is retained. The mean value over a window is calculated using only pixels that belong to the retained regions. The mean value is the filter result for the pixel.

The bi-level set filter results seem to have distinctive image patterns. This seems to be related to a good preservation of image edges. Histograms of variations, i.e. differences between adjacent pixels, are used to examine edge preservation. For Gaussian and Gamma filters, the tail of the histogram drops rapidly and is much lower than the noisy image. The tail of the bi-level set results is well above those filters and is close to the original data at the end. As expected, the mean-shift filter is better than Gamma and refined Lee filters for edge preservation.

The bi-level set filter provides good edge preserved results. Histograms of variations are useful for edge preservation evaluations.