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## Change detection in a time series of polarimetric SAR images

Henning Skriver, Allan Aasbjerg Nielsen, Knut Conradsen

A test statistic for the equality of two or several variance-covariance matrices following the real (as opposed to the complex) Wishart distribution with an associated probability of finding a smaller value of the test statistic is described in the literature [1]. In 2003 we introduced a test statistic for the equality of two variance-covariance matrices following the complex Wishart distribution with an associated probability measure [2]. In that paper we also demonstrated the use of the test statistic to change detection over time in both fully polarimetric and azimuthal symmetric SAR data.

To detect change in a series of  $k > 2$  complex variance-covariance matrices the pairwise test described in [2] may be applied to either consecutive pairs or to all possible pairs. The former would lead to a lack of ability to detect weak trends over time, the latter to an increase in the probability of false positives (postulating a change when there actually is none) and/or false negatives (missing an actual change). Therefore we need to test for equality for all time points simultaneously.

In this paper we demonstrate a new test statistic for the equality of several variance-covariance matrices from the real to the complex Wishart distribution and demonstrate its application to change detection in truly multi-temporal, polarimetric SAR data. Results will be shown that demonstrate the difference between applying to time series of polarimetric SAR images, pairwise comparisons or the new omnibus test statistic, where changes are clearly detected with the omnibus test, on the contrary to the pairwise comparisons, where no changes are detected. We also demonstrate how a factorization of the likelihood ratio statistic into a product of test statistics that each test simpler hypotheses of homogeneity up to a certain point can be used to detect at which points changes occur in the time series.

[1] T. W. Anderson, *An Introduction to Multivariate Statistical Analysis*, John Wiley, New York, third edition, 2003.

[2] K. Conradsen, A. A. Nielsen, J. Schou, and H. Skriver, "A test statistic in the complex Wishart distribution and its application to change detection in polarimetric SAR data," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 41, no. 1, pp. 4–19.