Change detection in time series of polarimetric SAR data by an omnibus test statistic and its factorization

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ABSTRACT

Based on an omnibus likelihood ratio test statistic for the equality of several variance-covariance matrices following the complex Wishart distribution with an associated p-value and a factorization of this test statistic, change analysis in a short sequence of multilook, polarimetric SAR data in the covariance matrix representation is carried out. The omnibus test statistic and its factorization detect if and when change(s) occur. The technique is demonstrated on airborne EMISAR L-band data but may be applied to Sentinel-1, Cosmo-SkyMed, TerraSAR-X, ALOS and RadarSat-2 or other dual- and quad/full-pol, and even single-pol data also.

1. INTRODUCTION

Test statistics for comparison of real (as opposed to complex) variance-covariance matrices exist in the statistics literature.[1] In earlier publications we have described a test statistic for the equality of two variance-covariance matrices following the complex Wishart distribution with an associated p-value.[2] We showed their application to bitemporal change detection and to edge detection[3] in multilook, polarimetric synthetic aperture radar (SAR) data in the covariance matrix representation.[4] The test statistic and the associated p-value is described in[5] also. In[6] we focussed on the block-diagonal case, we elaborated on some computer implementation issues, and we gave examples on the application to change detection in both full and dual polarization bitemporal, bifrequency, multilook SAR data.

In[7] we described an omnibus test statistic Q for the equality of $k \geq 2$ variance-covariance matrices following the complex Wishart distribution. We also described a factorization of $Q = \prod_{j=2}^{k} R_j$ where Q and R_j determine if and when a difference occurs. Additionally, we gave p-values for Q and R_j. Finally, we demonstrated the use of Q and R_j and the p-values to change detection in truly multitemporal, full polarization SAR data.

Here we illustrate the methods by means of airborne L-band SAR data (EMISAR).[8,9] The methods may be applied to other polarimetric SAR data also such as data from Sentinel-1, COSMO-SkyMed, TerraSAR-X, ALOS, and RadarSat-2 and also to single-pol data.

The account given here closely follows that given our recent IEEE TGRS paper.[7]

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