Test statistics for reflection symmetry, applications to quad-polarimetric SAR data for detection of man-made structures

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Corrections to "Test Statistics for Reflection Symmetry: Applications to Quad-Polarimetric SAR Data for Detection of Man-Made Structures"

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***Abstract*—In polarimetric synthetic aperture radar (SAR) images, speckle is removed by multilooking and the local covariance matrix is the main parameter of interest. In the covariance matrix from a backscatter with reflection symmetry, the terms $S_{hh}S_{hv}^*$, $S_{vv}S_{hv}^*$, and their complex conjugates are 0. The backscatter from natural covers, such as fields and forested areas, is typically reflection-symmetric, as these four elements have near-zero values. The backscatter from urban areas and man-made structures is substantially different, and the backscatter from buildings not aligned with the radar line of sight usually does not have reflection symmetry. A novel block-diagonality test statistic for reflection symmetry with a constant false alarm rate property is proposed. It is compared to an approximate test built on a change detection test statistic for Wishart-distributed covariance matrices. Their use on quad-polarimetric data in different situations shows their high potential for man-made structure detection. Applied after an orientation correction of the covariance matrices, these test statistics highlight with high-contrast buildings and urban areas. We also apply this test for ship detection at sea, and show that while the results are unconvincing at X-band, it can also be applied at longer wavelengths such as L-band.**

***Index Terms*—Building detection, radar polarimetry, reflection symmetry, synthetic aperture radar (SAR).**

I. Corrections

In [1] there is a typo in the expression for f immediately below Equation (8) on page 2879. The expression should be

$$f = p^2 - \sum_{\tau=1}^{t} p_\tau^2$$

which is what it correctly says in the appendix at the very bottom of the first column on page 2888.

There is also a typo in Equation (10) on page 2879 and in the last equation in the appendix on page 2889. In the expression for ω_2 we have erroneuosly divided by $n^2\rho^2$ both inside and outside the square brackets. The correct expression is

$$\omega_2 = \frac{1}{n^2\rho^2}\left[-\frac{1}{36}\frac{\{p^3 - \sum_{\tau=1}^{t} p_\tau^3\}^2}{p^2 - \sum_{\tau=1}^{t} p_\tau^2} + \frac{1}{24}\left\{p^4 - \sum_{\tau=1}^{t} p_\tau^4\right\}\right].$$

The accompanying Matlab code given on Allan Nielsen's homepage (https://people.compute.dtu.dk/alan) is not marred by these typos.

References

[1] P. Connetable, K. Conradsen, A. A. Nielsen, and H. Skriver, "Test statistics for reflection symmetry, applications to quad-polarimetric SAR data for detection of man-made structures," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 15, pp. 2877–2890, Mar. 2022, https://doi.org/10.1109/JSTARS.2022.3162670.

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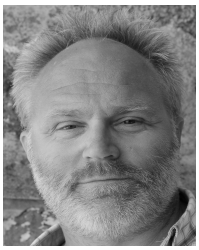
Knut Conradsen received the Cand. Scient. degree in mathematics in 1970 from the University of Copenhagen, Denmark. He has been with the Technical University of Denmark (DTU) since 1970. Presently he is Professor Emeritus of Statistical Image Analysis at the Department of Applied Mathematics and Computer Science, DTU. From 1995 to 2010 he was Provost (Deputy Rector) of DTU. His main research interest is the application of statistics and statistical models in primarily medical image analysis, remote sensing, material science and industrial applications. Work includes analysis of multi-/hyperspectral and multi-temporal data, as well from optical as from radar sensors.



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