

DOUBLE-BOUNCE CONTRIBUTION EFFECT IN THE ESTIMATION OF BIOPHYSICAL PARAMETERS OF VEGETATION BASED ON POLINSAR TANDEM-X BISTATIC DATA

Noelia Romero-Puig, Juan M. Lopez-Sanchez, J. David Ballester-Berman

Signals, Systems and Telecommunications Group, IUII, University of Alicante, Spain.

ABSTRACT

The inversion of the well-known Random Volume over Ground (RVoG) model [1, 2, 3] is employed for the estimation of physical parameters of scenes with vegetation by exploiting Polarimetric SAR Interferometry (PolInSAR) data [4].

Data gathered by the TanDEM-X satellite formation [5] are characterised by a single-pass bistatic configuration, where one satellite is transmitting and both of them are receiving, i.e. there is one monostatic image and one bistatic image. As a result from this bistatic configuration, the formulation of the interferometric coherence accounts for an extra decorrelation term: a double-bounce contribution at the ground which entails also volume effects from the interferometric point of view [1]. This double-bounce decorrelation factor has been overlooked in previous works exploiting TanDEM-X data on vegetation height estimation in forests [6, 7, 8, 9], and only considered in the inversion of the RVoG model over rice fields [10].

In this work we provide a detailed analysis of the effect of the double-bounce decorrelation factor on the inversion of scene parameters, with particular focus on the vegetation height. The study employs both simulated data as well as real data acquired over rice fields during the science phase of the TanDEM-X mission. The potential limitations of current inversion approaches are assessed, and the influence of both system parameters (i.e. incidence angle) and scene parameters (i.e. extinction coefficient and ground-to-volume ratios) is evaluated. Results show that the bias in the estimation of scene parameters is higher when the incidence angle is above 30 degrees, i.e. for shallow incidences. The normalised vegetation height, i.e. expressed as k_v , is used in order to extrapolate the results to other scenarios, e.g. forests.

1. REFERENCES

- [1] R. N. Treuhaft, S. N. Madsen, M. Moghaddam, and J. J. van Zyl, "Vegetation characteristics and underlying

This work is supported by the Spanish Ministry of Economy, Industry and Competitiveness, the State Agency of Research (AEI) and the European Funds for Regional Development (EFRD) under Project TEC2017-85244-C2-1-P. Noelia Romero received a grant from the Generalitat Valenciana and the European Social Fund (ESF), ref. ACIF/2018/204.

topography from interferometric radar," *Radio Science*, vol. 31, pp. 1449–1485, Nov. 1996.

- [2] R. N. Treuhaft and P. R. Siqueira, "Vertical structure of vegetated land surfaces from interferometric and polarimetric data," *Radio Science*, vol. 35, pp. 141–177, 2000.
- [3] K. P. Papathanassiou and S. R. Cloude, "Single baseline polarimetric SAR interferometry," *IEEE Trans. Geosci. Remote Sensing*, vol. 39, pp. 2352–2363, Nov. 2001.
- [4] S. R. Cloude and K. P. Papathanassiou, "Polarimetric SAR interferometry," *IEEE Trans. Geosci. Remote Sensing*, vol. 36, pp. 1551–1565, Sept. 1998.
- [5] G. Krieger *et al.*, "TanDEM-X: A satellite formation for high-resolution SAR interferometry," *IEEE Trans. Geosci. Remote Sensing*, vol. 45, pp. 3317–3341, Nov. 2007.
- [6] F. Kugler *et al.*, "TanDEM-X Pol-InSAR performance for forest height estimation," *IEEE Trans. Geosci. Remote Sensing*, vol. 52, pp. 6404–6422, Oct. 2014.
- [7] F. Kugler *et al.*, "Forest height estimation by means of Pol-InSAR data inversion: The role of the vertical wavenumber," *IEEE Trans. Geosci. Remote Sensing*, vol. 53, pp. 5294–5311, Oct. 2015.
- [8] S. K. Lee and T. E. Fatoyinbo, "TanDEM-X Pol-InSAR inversion for mangrove canopy height estimation," *IEEE J. Sel. Topics Appl. Earth Observ. Remote Sens.*, vol. 8, no. 7, pp. 3608–3618, 2015.
- [9] S. Abdullahi, F. Kugler, and H. Pretzsch, "Prediction of stem volume in complex temperate forest stands using TanDEM-X SAR data," *Remote Sensing of Environment*, vol. 174, pp. 197–211, Mar. 2016.
- [10] J. M. Lopez-Sanchez *et al.*, "Retrieval of vegetation height in rice fields using polarimetric SAR interferometry with TanDEM-X data," *Remote Sensing of Environment*, vol. 192, pp. 30–44, Apr. 2017.