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Assessment of polarimetric information for target detection improvement using SAR

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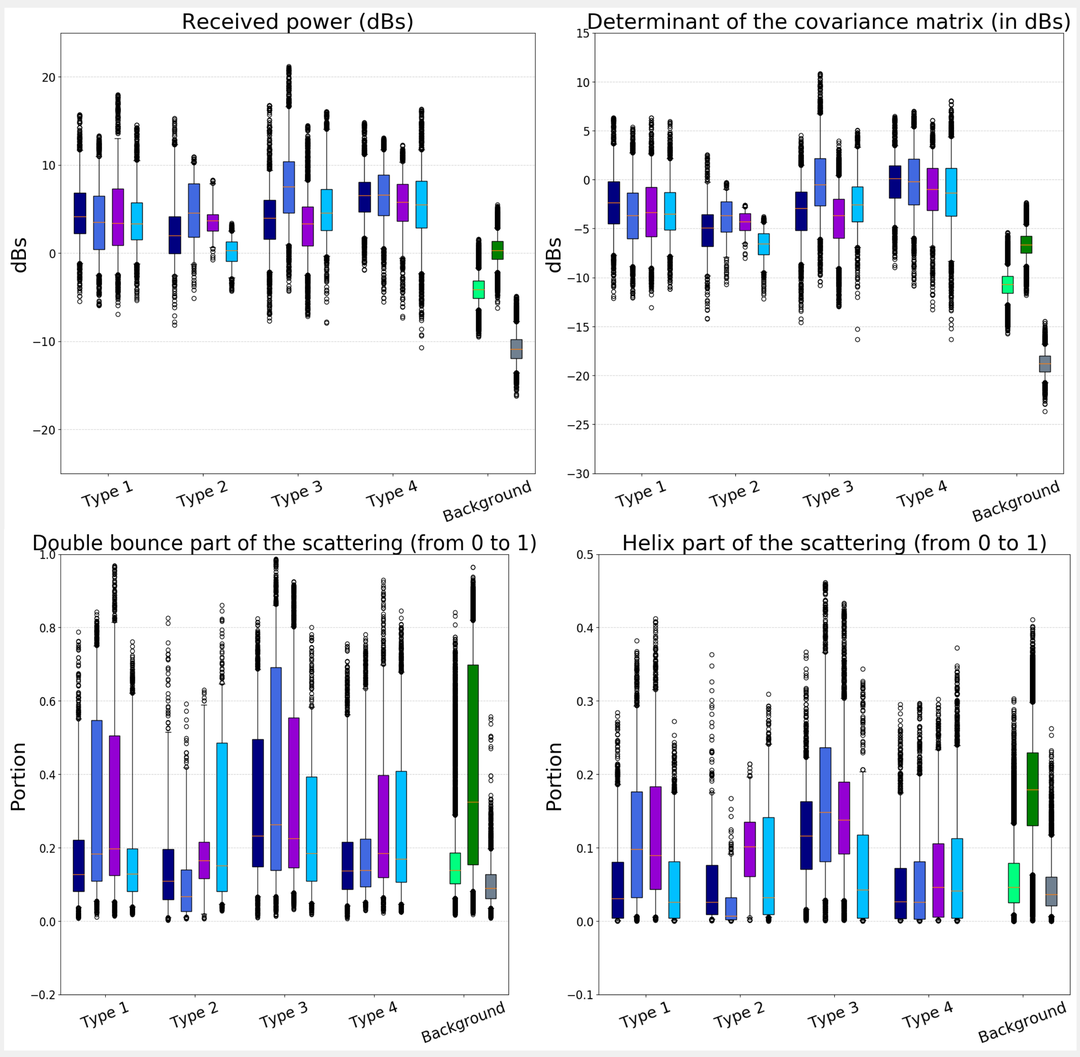
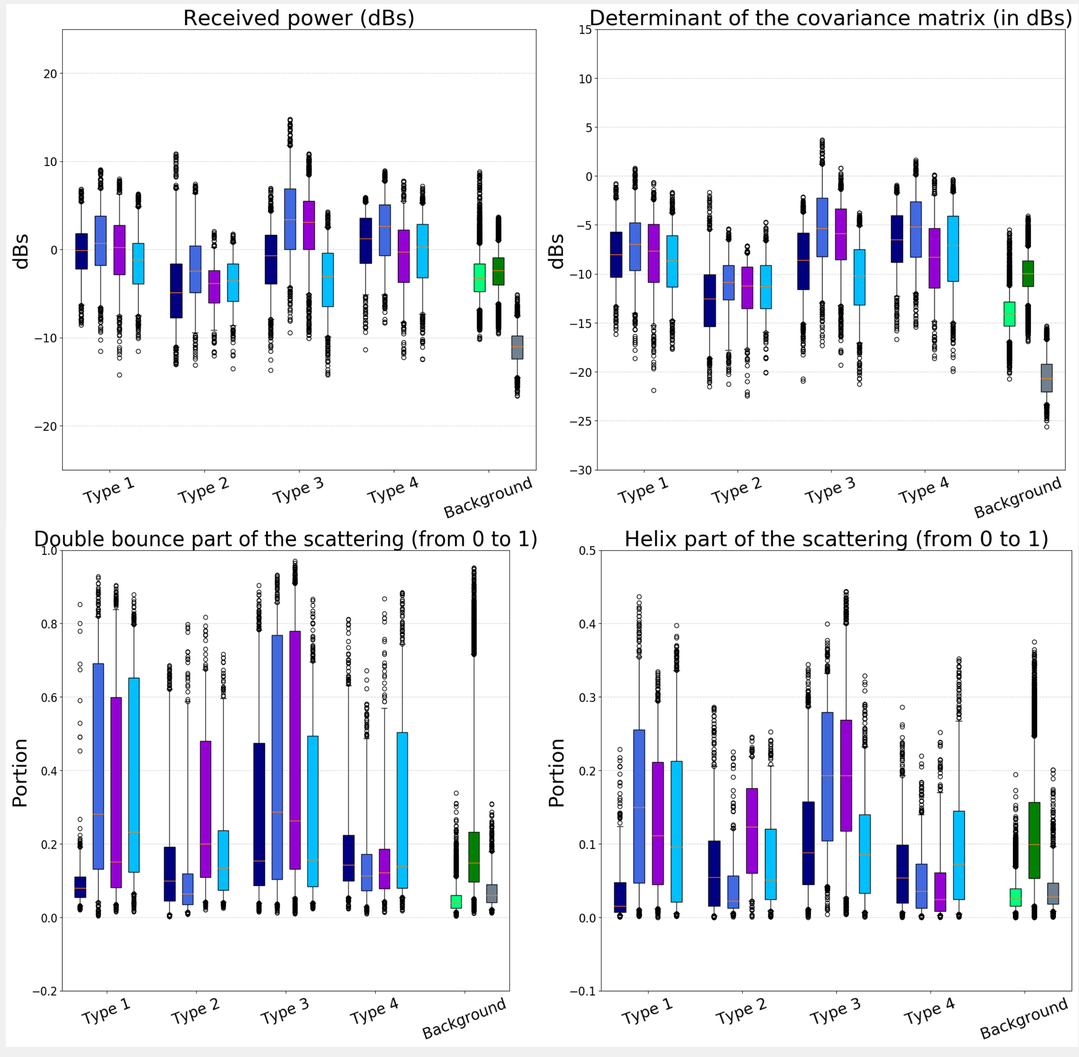
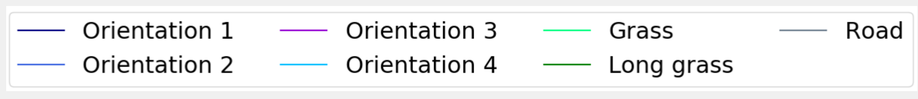
Fully polarimetric SAR gives valuable information on the nature of scattering mechanisms, which can be used for vehicle detection. This project aims at comparing the contrast between vehicles and background offered by different polarimetric features, at different wavelengths and under different orientation angles. The study is based on data acquired with DLR's F-SAR, in Oksbøl, Denmark, at X, S and L bands. This work can lead to further improvements in target detection by selecting individual features or a combination of features optimizing contrast between vehicles and their surroundings.

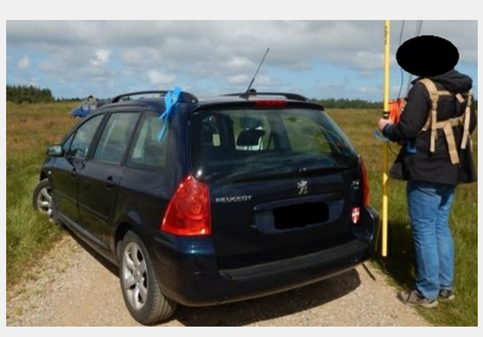
At X-Band



At L-Band







Pictures of the four types of vehicles present in the study. On the left column are a Unimog and a Piranha, and on the right column a car and a four wheeled vehicle. Each of these types of vehicle correspond to one of the Types in the experimental results.

The results presented in this study feature four different types of vehicles, named "Type 1" to "Type 4", as well as some representative pictures. The boxplots represent the pixel value distributions. The four different features for which results are presented can be separated in two groups. In the first one are the total received power and the determinant of the covariance matrix, both expressed in dBs. In the second group are the normalized part of double bounce scattering as described in [1], and the normalized helix part of the scattering [2]. These two later features are normalized by the total power, and therefore any contrast obtained with them is not correlated to the total power.

Analysis of the results

At X-band (ground resolution of 15 by 15 cm), features based on the total received power give the best contrast results, while the information on the type of scattering doesn't give as much contrast. As frequency decreases, information contained in type of scattering becomes more important. At L-band (ground resolution of 30 by 60 cm), the contrast offered by the total power and the determinant of the covariance matrix have decreased a lot. On the other hand, the contrast offered by the double bounce and the helix part of the scattering have both drastically increased.

Furthermore, the determinant of the covariance matrix gives interesting results. It gives information on both the total received power and the polarimetric complexity. It performs very similarly to the total power at X-band, and better than it at L-band.

Acknowledgments

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References

[1] J. J. Van Zyl, "Application of Cloude's target decomposition theorem to polarimetric imaging

radar data," 1993.

[2] E. Krogager, "Aspects of polarimetric radar imaging,"

Dr. Techn. Thesis, Technical University of Denmark, 1993.