Manifold learning and sparse identification in radar-based pattern recognition ADMOS 2019

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Key words: Numerical methods, nonlinear dimensionality reduction, manifold learning, machine learning, RCS, electromagnetism.

ABSTRACT

Fast, reliable and robust simulations are a major goal for industrial competitiveness. In electromagnetism, the *Radar Cross Section* (RCS) given by a scattering body (e.g., planes, cars) is a measure of how detectable it is by radars. Lately, it has become common practice to calculate the RCS of a target through simulation software before the final product is done in order to improve its performances quickly and optimize the manufacturing process[1]. In the framework of ADAS (Advanced Driver Assistance Systems), in fact, the study of RCS is used to develop cars that are readily capable to detect pedestrians and vehicles by analizing the radar signals received: this improves safety while driving and will eventually lead to the expansion of so-called autonomous cars.

In this project we aim to develop a methodology able to identify and classify targets starting from its RCS: after retrieving RCS values through CEM (Computational ElectroMagnetics) software, we postprocess them and perform a regression analysis by means of machine learning software tools.

RCS, however, depends on many parameters such as the material, the physical dimensions and the orientation of the target(s), the reflected angle of the radar beam. This requires the use of nonlinear dimensionality reduction techniques in order to avoid that phenomenum called *curse of dimensionality* in numerical modelling and which shows up when dealing with data in a high-dimensional space. After post-processing, thus, manifold learning algorithms need to be applied in order to move to a low-dimensional space.

This project is part of the Marie Skodowska-Curie ITN-ETN AdMoRe funded by the European Union Horizon 2020 research and innovation programme under grant agreement No 675919.

REFERENCES

[1] Kedzia J.C., De Souza P., Gruyer D., "Advanced Radar Sensors Modelling for Driving Assistance Systems Testing", *Proceedings of the EuCAP 2016 conference*, 2016, Davos, Switzerland, DOI: 10.1109/EuCAP.2016.7481398.