

# INTRODUCTION

The theory of electromagnetic waves polarimetry has been always a very active and profuse research topic. In a first period, researchers were mainly concerned about the basics of this theory. Whereas, the recent availability of high resolution radar devices has also opened the door for those scientists more interested into the applications of this theory, which main hobbyhorse has been to increase the knowledge about our environment and its dynamics. Therefore, an introduction to the main theoretical aspects of the theory is necessary for all those people willing to exploit polarimetric data by means of PolSARpro.

The following tutorial, which accompanies the PolSARpro software, pretends to be a guide into the theory of wave polarimetry. The text does not pretend to be an exhaustive treatise about polarimetry. The main objective of these pages is to provide PolSARpro users with the necessary knowledge to better understand the data treatment performed by the PolSARpro software. The tutorial has been divided into three main parts covering from the more formal and theoretical aspects about polarimetry to the main applications present nowadays. For those interested readers who want to look deeply into the details of this theory a comprehensive list of references is also provided.

The first part of this tutorial presents the basics of the polarimetric theory. In this sense, the text starts by defining the concept of wave polarimetry and studying the process of wave scattering. Then, some important subjects as speckle filtering, polarimetric decompositions and data classification are equally presented. This section ends by presenting the polarimetric capabilities of the ENVISAT/ASAR sensor. The second section of the tutorial introduces the basics of interferometric techniques. Next, this technique is combined with polarimetry giving as a result the polarimetric interferometric technique, which as shown at the end of this section, permits the analysis of forests characteristics. The final section focuses in a different application, in this case, the study rough surfaces. The four chapters of this section demonstrate that polarimetry allows the estimation of several parameters which characterize this type of natural scatterers.

All the concepts presented in the next tutorial are presented in a very intuitive way with abundant graphical schemes and a great number of examples with real data provided in the PolSARpro software package. Additionally, every chapter of this tutorial ends with a *Do it yourself* section, where the PolSARpro users can observe and learn the way to perform the different types of analyses which can be done with the software.

Finally, we would like to mention that this tutorial is not provided in its final version. Due to the fact that the PolSARpro software package is offered as a *beta* version, the *Do it yourself* sections will be finished once the software has been completely tested.