Contribution ID: **182**

Type: **not specified**

Neural network for improving the flux density estimations in polarization of compact sources.

Tuesday, 9 July 2024 09:40 (20 minutes)

The importance of galaxy clusters and extra-galactic sources seen as compact or point sources (PS) in ground- and space-based CMB experiments has been clear since the conception of the Wilkinson Microwave Anisotropy Probe and Planck missions. PS in the microwave regime are mainly blazars that affects recovery of the CMB anisotropy signal especially at small angular scales. Unresolved polarized PS could be one of the main contaminants to the primordial B mode detection. Therefore, it is important to develop highly performing methods for PS detection in polarization. On the other hand, the importance of such estimation is not only important for CMB recovery, but also for the astrophysical studies of extragalactic sources.
We are exploring the application of Convolutional Neural Networks to enhance the performance of the flux density estimations. Artificial Neural Networks are artificial intelligence techniques involving numerical mathematical models inspired by the human brain, which can be trained to represent complex physical systems by supervised or unsupervised learning. Some approaches, such as the Convolutional Neural Networks, have been successfully applied to image processing (and related fields) for modelling and forecasting and their evolution.
An overview of our Neural Network approach and the results obtained so far will be presented. We develop and train a machine learning model called POSPEN to learn how to estimate the polarisation flux density and angle of point sources embedded in cosmic microwave background images knowing only their positions. We studied the performance of our model with the detected sources of the Second Planck Catalogue of Compact Sources (PCCS2) at the frequencies with polarization measurement and typically improving the number of estimations, especially in the 217 GHz Planck map which is the poorest one among the PCCS2 catalogue.

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Session Classification: Past and future multiwavelength all-sky surveys