Session 4

(Invited) Unlocking the potential of deep learning for the analysis of spectropolarimetric observations

C. J. Díaz Baso
RoCS UiO

The solar magnetic field is responsible for most of the physical processes in the solar atmosphere and their many manifestations. It can be inferred by analyzing polarimetric observations of spectral lines. Outside strong active regions, these signals are particularly weak, and in most cases very close to the detection limit of the current instrumentation. In addition, the modeling of the intensity and polarization signatures in spectral lines that form in the upper atmosphere prevents the use of inference techniques in large observed fields or in time-evolution analyses due to the extensive computational time. This, combined with the fact that the volume of data collected nowadays is unprecedentedly large, shows that these observations cannot be reasonably analyzed with conventional methods. In the last decade, machine learning and neural networks have emerged as powerful tools to extract the relevant information from these massive collections, analyze the data, and in short improve and accelerate the whole process. In this contribution, I will present several successful deep learning-based solutions for recovering weak polarization signals under complex noise corruption, robust image deconvolution, acceleration of spectropolarimetric inversions, and Bayesian uncertainty quantification. I will discuss their implications and provide an outlook for future research.