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Machine learning in exoplanetary spectroscopy: removing the human bias

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Exoplanetary spectroscopy is one of the fastest evolving fields in current astrophysics. Driven by the great success of recent years, it consistently finds itself on the frontier of technical feasibility. Before the advent of dedicated spectrographs on ground-based facilities (such as the proposed VLT/EXPRESSO spectrograph) or space telescopes (such as the proposed EChO or FINESSE missions) exoplantary spectroscopy relies on instruments not specifically designed for the task. These generic instruments often lack a sufficiently defined instrument response functions and achieving typical photometric stabilities of 1 photon in 10000 quickly becomes the main challenge of the field.
Parametric de-correlation of the data is a way forward but is often hampered by a certain degree of 'arbitrariness' regarding the way in which the data is corrected for which varies from author to author.

It now becomes interesting to know how well we can calibrate the data without any additional or prior knowledge of the instrument or star. Using techniques commonly employed in data intensive fields such as image processing, communications, medial physics and other areas of astrophysics, we can show that a good degree of so called 'non-parametric' data de-trending is achievable. Such non-parametric approaches, which heavily rely on unsupervised machine learning algorithms and wavelet analyses, have the unique advantage of removing biases and said 'arbitrariness' and can most times be employed with a fraction of the effort compared to the parametric approach.

In this conference, we will introduce, discuss and illustrate these machine learning techniques given key examples of exoplanetary spectra in the literature.