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A Deep Learning Pipeline for Unified Modelling of Time-Correlated Noise in Exoplanets Observations

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The precise derivation of transit depths from stellar light curves is a key component in the construction of exoplanet transit spectra, and thereby for the characterization of exoplanet atmospheres. However, it is still deeply affected by various kinds of complex systematic errors and noises taking their source from host stars' or instruments' variability. On the other hand, as the volume of exoplanetary data is quickly increasing, a new way is being opened up for using machine learning as part of the data processing pipeline. By training a recurrent neural network to model the temporal dependencies in stellar light curves, our results on both real on simulated light curves highlight that it is possible to:

- Model accurately the compound of trends and periodic effects with few or no assumptions about the instrument, star, or planetary signals
- Improve the understanding of each instrument's systematic behaviour
- Optimise a deep detrending model jointly with a transit fit
- Leverage the cross-light curves and cross-instruments information

Such an approach therefore paves the way for a global, flexible and efficient noise-correction pipeline which will be of paramount importance to make the most of exoplanets observations and provide high precision spectra to subsequent atmospheric retrieval pipelines.