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Data-driven Methods for Mitigating Stellar Variability in Sun-as-a-Star Observations

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The search for Earth-like planets around Sun-like stars using Doppler radial velocity (RV) measurements is challenged by stellar variability. Stellar variability alters the shapes of spectral lines, introducing spurious RVs that obscure the true RV signals of planets.

To address this issue, we study the Sun as a star, where we know the ground truth of the solar RVs as a result of solar variability. Our experiment begins by extracting line shape information from the "Sun-as-a-star" observations using FIESTA (Zhao et al., 2022), a Fourier-based parameterization of the spectral cross-correlation function. We then feed these extracted features into a 2D convolutional neural network to predict the resulting solar RVs. Furthermore, this model can be transferred to other Sun-like stars for predicting their stellar variability RVs in general.

This method will help us separate the stellar RV noise from the planetary RV signals, which is essential for accurately detecting exoplanets amidst stellar noise.

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