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EncoTESS: Age Inference from Raw TESS Light Curves

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Stellar ages are a foundational component of astronomy research, but are notoriously difficult to measure for low mass main sequence stars. Fortunately, variability indicators such as rotation period, flaring rate, and amplitude of flux variability can provide some age constraints, but they evolve in nonlinear and non-monotonic ways. Furthermore, these indicators are typically characterized as summary statistics from time series data, but these are often noisy, treated independently, and do not capture all of the useful information contained in raw light curves. With the recent advances in ML/AI and computing combined with the vast number of light curves available from Kepler and TESS, there is a prime opportunity to apply more data-driven methods. To that end, I have developed and here present \texttt{EncoTESS}: a Time Series Foundation Model that can be used to estimate stellar ages from raw TESS light curves without using summary statistics. I show that through self-supervised training, \texttt{EncoTESS} naturally captures stellar variability, and that it can be used to infer the ages of young M dwarfs with more accuracy and precision than rotation-based models. \texttt{EncoTESS} is designed with consideration of crucial systematics such as noisy, heteroskedastic data with large gaps, and implements an architecture expandable to multi-cadence and multi-survey light curves for broader applicability in the future. It is also ~1% of the size of typical literature Time Series Foundation Models, and can be run easily on any modern laptop.

Did you give a contributed talk at CASCA 2026?

No

If you are selected for a poster, would you be interested in giving a short flash talk on your work?

Yes

What is your career level?

PhD

Which keyword describes the area of focus of this talk?

Stars & stellar clusters

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