

Sujay Nair

sujaynair03.github.io, sujaynr@ohs.stanford.edu, 1-530-400-1064

PROFILE	High school researcher passionate about astronomy and its intersection with computational/data science. Specifically interested in exoplanets and automated prediction of their planetary properties.
EDUCATION	Stanford Online High School (OHS) / California High School 2019-2022 <i>Relevant Coursework:</i> <i>10th:</i> AP Computer Science, AP Calculus BC, Astrophysics/Astronomy Research Seminar, AP Statistics <i>11th:</i> Linear Algebra, Differential Equations, AP Physics C Mechanics, AP Physics C Electricity & Magnetism, Data Structures & Algorithms in Java <i>12th:</i> Multivariable Calculus, Light & Heat (Optics and Thermodynamics), Modern Physics (Relativity and Quantum Mechanics), Advanced Topics in Computer Systems, Data Science
RESEARCH EXPERIENCE	Freshening Exoplanet Transit Midpoints <i>Presented: 235th Meeting of the American Astronomical Society (AAS) 2020 CubeSat Workshop</i> In this study, we studied the effects of different comparison stars on the corresponding light curve and worked with 6 photometric functions. Poster: http://tiny.cc/oykfqz Utilizing Small Telescopes by Citizen Scientists for Transiting Exoplanet Follow-Up <i>Published: Publications of the Astronomical Society of the Pacific (PASP)</i> https://arxiv.org/abs/2003.09046 From analyzing mid-transit times for many exoplanets, observations from small (<1m) telescopes can increase observational efficiency of large observatories. Investigation of 14 Wide Common Proper Motion Doubles <i>Published: Journal of Double Star Observations (JDSD)</i> http://www.jdso.org/volume16/number2/Caputo_173_182.pdf We investigated 14 physical systems from the Washington Double Star Catalogue. We used our measurements to assess the probability of gravitational relationships. Analysis of HAT-P-23b, Qatar-1b, WASP-2b, and WASP-33b with an Optimized EXOplanet Transit Interpretation Code <i>Published and Presented: Society for Astronomical Sciences (SAS)</i> http://www.socastrosci.org/images/2020_Proceedings_final.pdf (155-165) We analyzed 4 exoplanets and edited the Exoplanet Transit Interpretation Code to provide faster photometric analysis. Analysis of Candidate Exoplanet TOI717.01 and Confirmed HAT-P-3b <i>Published and Presented: SAS</i> http://www.socastrosci.org/images/2020_Proceedings_final.pdf (177-183) Analysis of transit properties of 2 exoplanets with 7 total image reduction methods. Transit Analysis of Exoplanets TrES-5b and WASP-43b <i>Published: Research Notes of the AAS (RNAAS), Presented: 236th AAS Oral Session - Extrasolar Planets III: Transits and Populations</i>

<https://iopscience.iop.org/article/10.3847/2515-5172/ab98f5>

https://www.youtube.com/watch?v=pXhum_21gyY

We analyzed the transit properties of TrES-5b using many comparison stars and explored its extremely dim host star.

Mid-transit and Reference Star Analysis of HAT-P-37 b and Kepler-45 b

Presented: Exoplanet3 Heidelberg

<https://iopscience.iop.org/article/10.3847/2515-5172/ab98f5>

We analyzed the mid-transit times and comparison stars for the exoplanets HAT-P-37 b and Kepler-45 b. Poster list: https://hdconfsys.zah.uni-heidelberg.de/exoplanets3/poster_list.html

Transit Analysis of TOI 1780.01

Presented: ExoDem 2020 Caltech

(Poster not publically available)

We analyze the mid-transit times and comparison stars for the exoplanet TOI 1780.01.

Citizen Scientist Transit and Comparison Star Analysis of HATS-4 b with the East Bay Astronomical Society

Presented: IPoster for AAS 237

Link to Poster

6 members of the East Bay Astronomical Society will be introduced to the Exoplanet Transit Interpretation Code (EXOTIC) and will be guided through a complete transit and reference star analysis. Training Example: <https://www.youtube.com/watch?v=KGdnoKfhMPw>

Using Deep Learning with Phase Folded Light Curves to Detect Exoplanets

Presented: IPoster presentation for AAS 237

Link to Poster

We extend the work of transit detection by utilizing phase folded light curves to train a convolutional neural network to predict the existence of an exoplanet. We propose a scheme to generate synthetic data mimicking TESS observations from a single sector where the positive training samples are randomly generated transit data phase folded at the correct period, and the negative training samples are folded at a random incorrect period.

Sequence-based Encoding of Light Curves for Exoplanet Detection

Presented: IPoster presentation for AAS 238

Link to Poster

We explore the benefits of using recurrent neural networks for predicting the existence of an exoplanet. We tested LSTM layers in our Convolutional Neural Network (CNN) versus our standard CNN with synthetically generated light curves with varying amounts of noise.

Crowd-sourcing the Updating of Exoplanet Transit Timing Variations and Detecting Exoplanets using Deep Learning

First place at Washington State Science and Engineering Fair (WSSEF)

Wolfram Research Award

NASA Earth Systems Science Award

This summarizes my research in the area of updating exoplanet transits, crowd-sourcing the exoplanet transit effort, and deep learning for exoplanet detection.

Using Deep Learning to Predict Exoplanet Planetary Parameters based

on Generated Light Curves

In Progress

In this project we train a 1D Convolutional Neural Network to take as input artificially generated light curves mimicking TESS observations at a 2 min cadence and output a list with predicted planetary parameters-namely, R_p/R_s , Period, a/R_s , and T-mid. Comparing to the current state of the art algorithm, Transit Least Squares (TLS), which does not rely on machine learning, our R_p/R_s mean absolute error is roughly the same. We are still tuning the model to reach TLS performance for Period.

ADDITIONAL COURSEWORK	Data Science Specialization (10 Courses), Johns Hopkins University	2018-19
	Deep Learning Specialization (5 Courses), deeplearning.ai	2019-20
	XSeries Program in Astrophysics (4 Courses), ANU	2020-21
TECHNICAL SKILLS	Coding/Data Analysis: Deep Learning, Python (Tensorflow, Numpy), R, Java, C, Google Cloud Platform Astronomy: Exoplanets, Double Stars, Astrophysics	