Sujay Nair

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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

Relevant Coursework:

10th: AP Computer Science, AP Calculus BC, Astrophysics/Astronomy Research Seminar, AP Statistics

11th: Linear Algebra, Differential Equations, AP Physics C Mechanics, AP Physics C Electricity & Magnetism, Data Structures & Algorithms in Java

12th: 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

Quinn Perian, Sujay Nair, Kalee Tock

Presented: 235th Meeting of the American Astronomical Society (AAS)

2020 CubeSat Workshop

In this study, we studied the effects of different comparison stars on the corresponding light curve and worked with 6 photometric functions.

Link to Poster

Utilizing Small Telescopes by Citizen Scientists for Transiting Exoplanet Follow-Up

Zellem et al.

Published: Publications of the Astronomical Society of the Pacific (PASP) Link to Paper

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

Caputo et al.

Published: Journal of Double Star Observations (JDSO)

Link to Paper

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

Sujay Nair, Jonathan Varghese, Kalee Tock, Robert Zellem

Published and Presented: Society for Astronomical Sciences (SAS)

Link to Paper

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

Sujay Nair, Krithi Koodli, Elliott Chalcraft, Kalee Tock

Published and Presented: SAS

Link to Paper
Analysis of transit properties of 2 exoplanets with 7 total image reduction methods.

Transit Analysis of Exoplanets TrES-5b and WASP-43b
Sujay Nair, Jonathan Varghese
Published: Research Notes of the AAS (RNAAS), Presented: 236th AAS Oral Session - Extrasolar Planets III: Transits and Populations
Link to Paper
Link to RNAAS Interview
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
Sujay Nair
Presented: Exoplanet3 Heidelberg
We analyzed the mid-transit times and comparison stars for the exoplanets HAT-P-37 b and Kepler-45 b.
Link to Poster List (Poster not publicly available)

Transit Analysis of TOI 1780.01
Sujay Nair
Presented: ExoDem 2020 Caltech
Link to Poster
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
Sujay Nair, Caroline Scolari, Jay Kelath, Aishwarya Rammohan, Richard Ozer, Gloria Ng, Wesley Chang, Pat Boyce
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

Using Deep Learning with Phase Folded Light Curves to Detect Exoplanets
Sujay Nair, Kyle Pearson
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
Sujay Nair, Kyle Pearson
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
Sujay Nair
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
Sujay Nair, Kyle Pearson
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, Rp/Rs, Period, a/Rs, and T-mid. Comparing to the current state of the art algorithm, Transit Least Squares (TLS), which does not rely on machine learning, our Rp/Rs mean absolute error is roughly the same. We are still tuning the model to reach TLS performance for Period.

HONORS & AWARDS

Betty Neall Youth Award of Merit, East Bay Astronomical Society 2021
1st Place, Washington State Science and Engineering Fair 2021
Wolfram Research Award, Washington State Science and Engineering Fair 2021
NASA Earth System Science Award, Washington State Science and Engineering Fair 2021
Select Interview for the Research Notes of the American Astronomical Society, American Astronomical Society 2020
President's Award for Educational Excellence, President's Educational Awards 2019

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), Australian National University 2020-21

TECHNICAL SKILLS

Coding/Data Analysis: Deep Learning, Python (Tensorflow, Numpy), R, Java, C, C++, Google Cloud Platform
Astronomy: Exoplanets, Double Stars, Astrophysics