# CALIFORNIA STATE SCIENCE FAIR
# 2017 PROJECT SUMMARY

**Name(s)**

Hagop J. Chinchinian

**Project Number**

**S1505**

**Project Title**

## Algorithmic Radio Data Classification and Pulsar Detection Using MATLAB

**Abstract**

**Objectives/Goals**

The objective is to automate the scoring process for Fast Fourier Transform plots, which represent a radio signal as observed by a telescope. The algorithm calculates a score for the subplots which constitute an FFT plot (the method by which humans manually analyze FFT plots) and classifies the source of the signal as a pulsar, radio frequency interference (RFI), and noise.

**Methods/Materials**

MATLAB was used in order to develop the algorithm (along with the Statistical Analysis Toolbox and the Image Processing Toolbox).

The development of the algorithm focused on identifying patterns in the Fast Fourier Transform plots, assigning scores based on these patterns, and classifying the plots into a radio source (pulsar, RFI, or noise).

**Results**

The algorithm was tested with 200 FFT plots, and the algorithm had an 81.8% similarity to the human rating. A 95% confidence interval was calculated, showing that the true percent similarity between the algorithm and human rating is between 77% and 88%.

A chi-squared test of homogeneity was applied to determine if the radio source classifications were accurate (testing if the distribution of algorithm and human classifications were the same). The chi-squared test showed no significant difference between the distributions of algorithm and human classifications.

**Conclusions/Discussion**

Testing the algorithm showed that it was relatively accurate in scoring the FFT plots and determining the signal source.

In order to improve the algorithm and its accuracy, it is suggested that a database be established for which the algorithm can refer to when scoring plots. This will enhance the algorithm when determining the scores/classifications of plots that do not distinctly show patterns representing pulsars, RFI, and noise. Machine learning algorithms may also be implemented.

**Summary Statement**

An algorithm was developed in order to analyze Fast Fourier Transform plots, which represent radio signal data, by automatically scoring the plots on a scale (used when manually scoring such plots) and determining the source of the signal.

**Help Received**

The algorithm was fully designed by myself, and Mr. Paul Mekhedjian answered my questions regarding the mathematics behind the algorithm. The data was obtained from the Pulsar Search Collaboratory (PSC). Dr. Raymond Ellyin provided general feedback on the project and is the PSC adviser at my school.