Assignment 3

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COURSE CODE:DAASE

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Question

Theory

Pulsar: It is a highly magnetized rotating neutron star that emits beams of electromagnetic radiation out of its magnetic poles.This radiation can be observed only when a beam of emission is pointing toward Earth.

Fourier Transform: It is a mathematical model which helps to transform the signals between two different domains, such as transforming signal from frequency domain to time domain or vice versa.Taking a Fourier transform of a time domain signal helps to know the frequency present in signal.Using this,any periodic function (continuous function) can be expressed as sum of series of sine and cosine terms.It gives a peak at the frequency present in the signal in the frequency domain.

$$F(w) = \frac{1}{2\pi}\int_{-\infty}^{\infty} f(t)e^{-i\omega t}dt$$

Where,
F(ω) = frequency domain continuous function
f(t) = Time domain continuous function
t = time
ω = angular frequency
However, discrete values are stored instead of continuous values in computer disc.
For discrete signal/data,**Fast fourier transform** is used where "discrete" time domain data is converted it into frequency domain data.

$$F[k] = \frac{1}{2\pi}\sum_{n=0}^{N-1} f[n]e^{-2\pi ikn/N}dt$$

Where,
F[k] = Sample in frequency
f[n] = Sample in time
n = time index
k = frequency index
N = Number of samples
.

Working

From the given data set, variables to be plotted are initialised as individual arrays and then using plot() function of pyplot module from matplolib library of python.Array xdata contains the time of ydata(flux) recording.Using rfftfreq()function of scipy.fft module fast fourier transformation is performed on xdata and the values are stored in another array naming xf.Next, using rfft() fast fourier transformation is done on ydata and the new values are stored in yf array.Both ,data in xf and yf are converted into frequency domain .Then these variables are plotted in log scale(base 10).Then,to remove the trend linear function is fitted and then values in y axis are subtracted from the y values of the linear function. Thus, the gaussian nature of the curve is now present so, a gaussian function is used to fit the curve inorder to get the peak frequency.

Plots,Calculation and Discussion

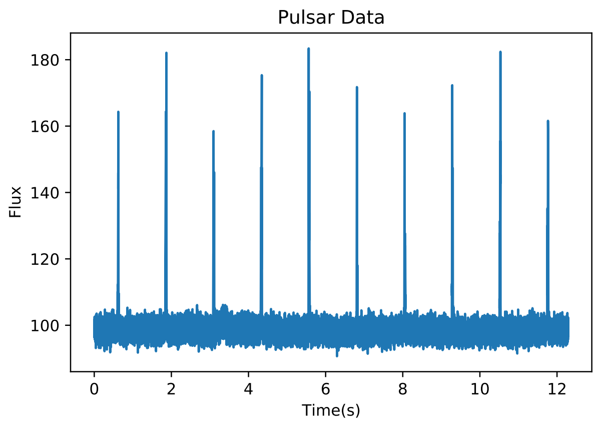

Figure 1: In Time Domain

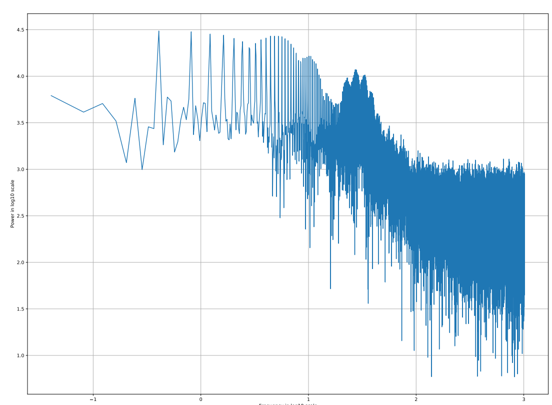

Figure 2: In Frequency Domain

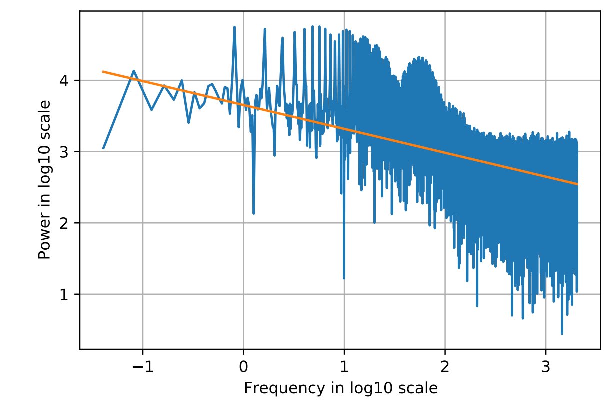

Figure 3: Fitting linear function

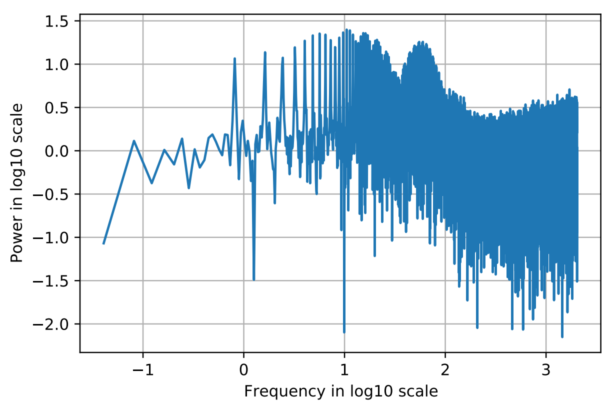

Figure 4: After removing the trend

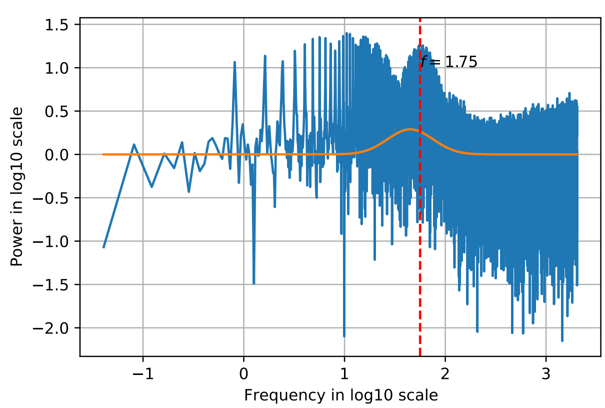

Figure 5: With Gaussian fitting

Calculation: from the plot ,f =$10^{1.75}Hz$
time period(T)=1/f=$17.38ms$
It is a millisecond pulsar.