%This script analyses time-series in a .xls file. Using IMAGEJ a grid of 60x60 squares was used to measure bioluminescence over a z-stack.

%The Z-stack is a progression of time of 2 frames per hour.

%This script smooths the data, analyses amplitude and phase differences, and then plots this data in a heatmap that corresponds with the morphological locations of the

%original square .

%% %% read in data file, removes outlier data points (caused by random photons) and smooths data %%

[fileName, filePath] = uigetfile('\*.xlsx');

M = xlsread(strcat(filePath,fileName)); %read in data

rawdataMat = M(:,2:end);

for ind = 1:size(rawdataMat,2) %removes spikes due to photons via hampel outlier removal

 y = hampel(rawdataMat(:,ind));

 rawdataMat(:,ind) = y;

end

dataMat=smoothdata(rawdataMat) ; %smooth data

%% Locate peaks ;

locMat = NaN(1,3600); %pre-allocate

pksMat = NaN(1,3600);%pre-allocate

promMat = NaN(1,3600);%pre-allocate

 figure(3)

for i= 1:3600 %Calculates the location and prominence of the first peak per time-series

 subplot(1,2,2);

 hold on

findpeaks(dataMat(30:75,i),'minPeakProminence',20,'minPeakDistance',10, 'minPeakWidth',6, 'NPeaks', 1);

[pks, locs, w, prom] = findpeaks(dataMat(30:75,i),'minPeakProminence',5,'minPeakDistance',10, 'minPeakWidth',6,'NPeaks', 1);

%30:75 is a window for the first peak. This was found manually and will depend on when the recording starts

locMat(1:length(locs),i) = locs;

pksMat(1:length(pks),i) = pks;

promMat(1:length(pks),i) = prom;

end

subplot(1,2,2);

%% Find amplitude and variance

% prominence of peak is used to represent amplitude

%timing of the peak is used to calculate phase differences from average phase

locMatinhours=locMat/2; %2 frames per hour were measured

averagepeaktime=nanmean(locMatinhours)

variance= locMatinhours(:)-averagepeaktime; % define variance as the deviation of average peak time

subplot(2,2,1); %plot variance into a heatmap

variancesq = reshape(variance,[60,60]);

 variancesq=variancesq';

 heatmap(variancesq)

 title('dysynchrony')

subplot(2,2,3)%plot amplitude into a heatmap

amplsq = reshape(promMat,[60,60]);

amplsq = amplsq';

heatmap(amplsq)

title ('ampl from baseline')

%% Moving average

%Specific time-traces were selected based on their morphology. The base

%line substraction of these was performed via:

M = movmean(dataMat,48); %48 frames results a 24 hour moving average

dataMatsubbase=dataMat - M; %

figure(2)

plot(dataMatsubbase)