```
clearvars
format long
```

Milestone 1 (6 October)

Data Exploration of BD+55_441

For this milestone, BD+55_441 is displayed and explored in detail. The other sources are briefly imported in upcoming sections.

```
opts = detectImportOptions("BD+55_441.txt");
opts.DataLines = 3;
opts.VariableNames = {'B_time','B_flux','R_time','R_flux','V_time','V_flux'};
```

"time" is in the units of days and "flux" is "rel_flux_T1" from AstroImageJ outputs.

```
opts.VariableTypes = {'double','double','double','double','double','double'};
preview("BD+55_441.txt",opts)
```

ans = 8×6 table

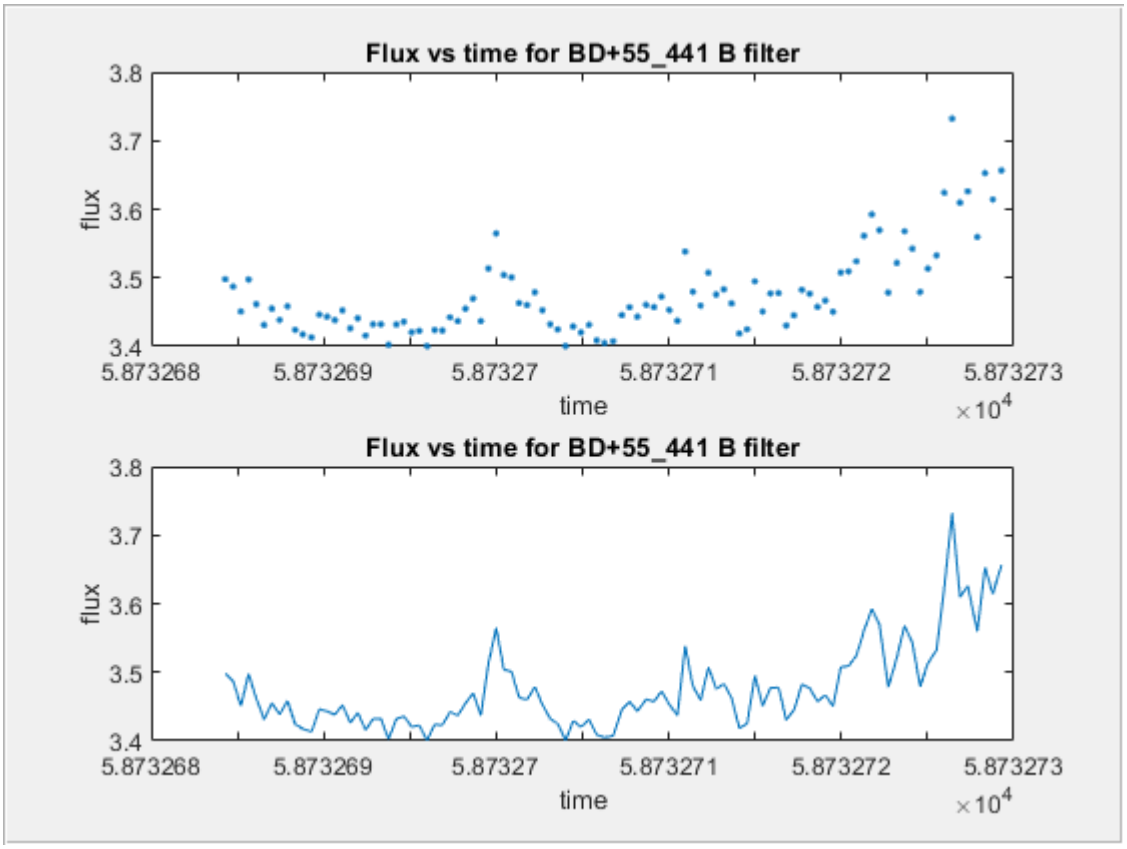
	B_time	B_flux	R_time	R_flux	V_time	V_flux
1	5.873268430...	3.497996...	5.873268459...	1.961830...	5.873268445...	2.352058...
2	5.873268430...	3.497996...	5.873268504...	1.942857...	5.873268490...	2.360458...
3	5.873268475...	3.487289...	5.873268549...	1.947021...	5.873268535...	2.329957...
4	5.873268520...	3.450942...	5.873268594...	1.930594...	5.873268580...	2.344889...
5	5.873268565...	3.497567...	5.873268639...	1.942537...	5.873268625...	2.361048...
6	5.873268610...	3.461555...	5.873268684...	1.935141...	5.873268669...	2.333341...
7	5.873268655...	3.431248...	5.873268729...	1.931290...	5.873268714...	2.331904...
8	5.873268700...	3.455091...	5.873268774...	1.928260...	5.873268759...	2.323782...

```
BD55_441 = readmatrix("BD+55_441.txt",opts);
whos BD55_441
```

```
  Name            Size            Bytes  Class     Attributes

  BD55_441      101x6              4848  double
```

```
hf_sub(1) = figure(1);
hp(1) = uipanel('Parent',hf_sub(1),'Position',[0 0 1 1]);
subplot(2,1,1,'Parent',hp(1));
plot(BD55_441(:,1),BD55_441(:,2),'.')
title('Flux vs time for BD+55\_441 B filter');
xlabel('time'),ylabel('flux');
subplot(2,1,2,'Parent',hp(1));
plot(BD55_441(:,1),BD55_441(:,2)),title('Flux vs time for BD+55\_441 B filter')
xlabel('time');
ylabel('flux');
```



Noting the graph above - displayed in discrete points and as a line graph - there is some periodicity. There are peaks at 58732.70, 58732.711 and 58732.722.

```
r = abs([0; BD55_441(:,1)] - [BD55_441(:,1);0]);
round(mean(r(3:end-1)),8) %average period between measurements
```

```
ans =
     4.543400000000000e-04
```

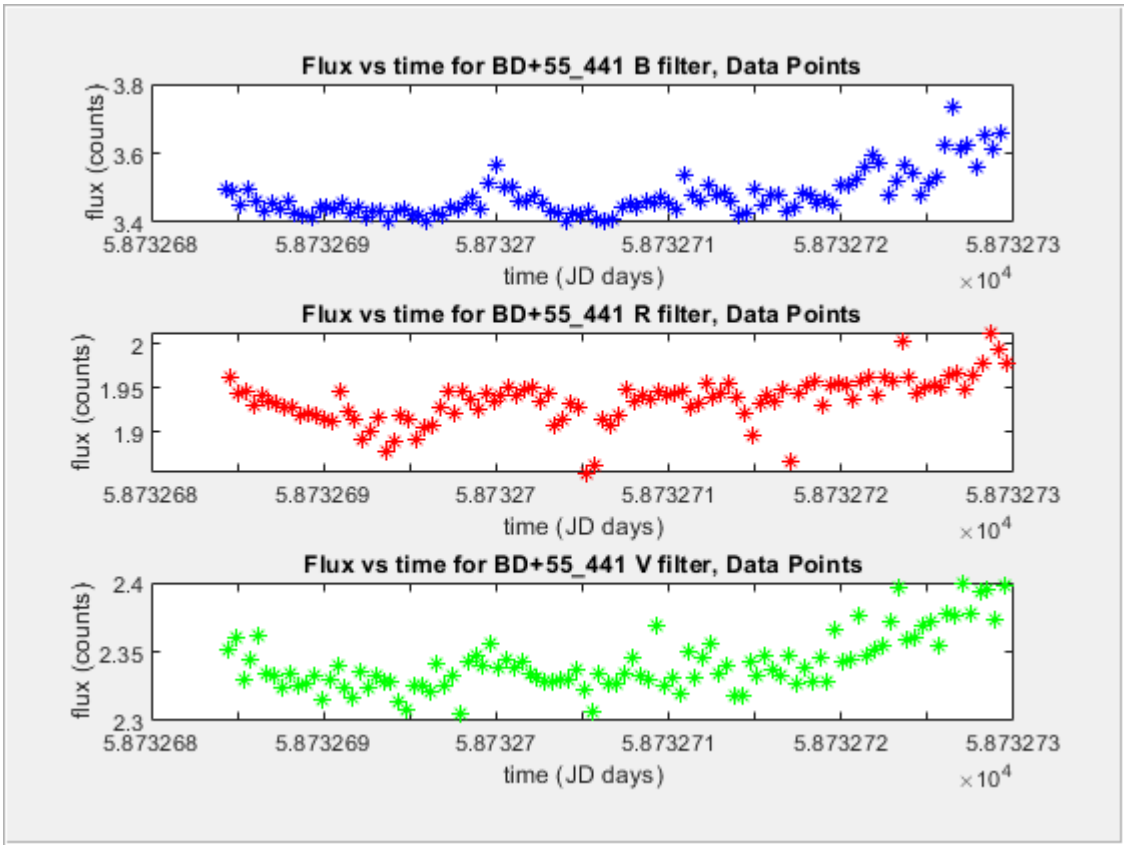
```
round(std(r(3:end-1)),8) %standard deviation - as a measurement of variation in period
```

```
ans =
     1.885000000000000e-05
```

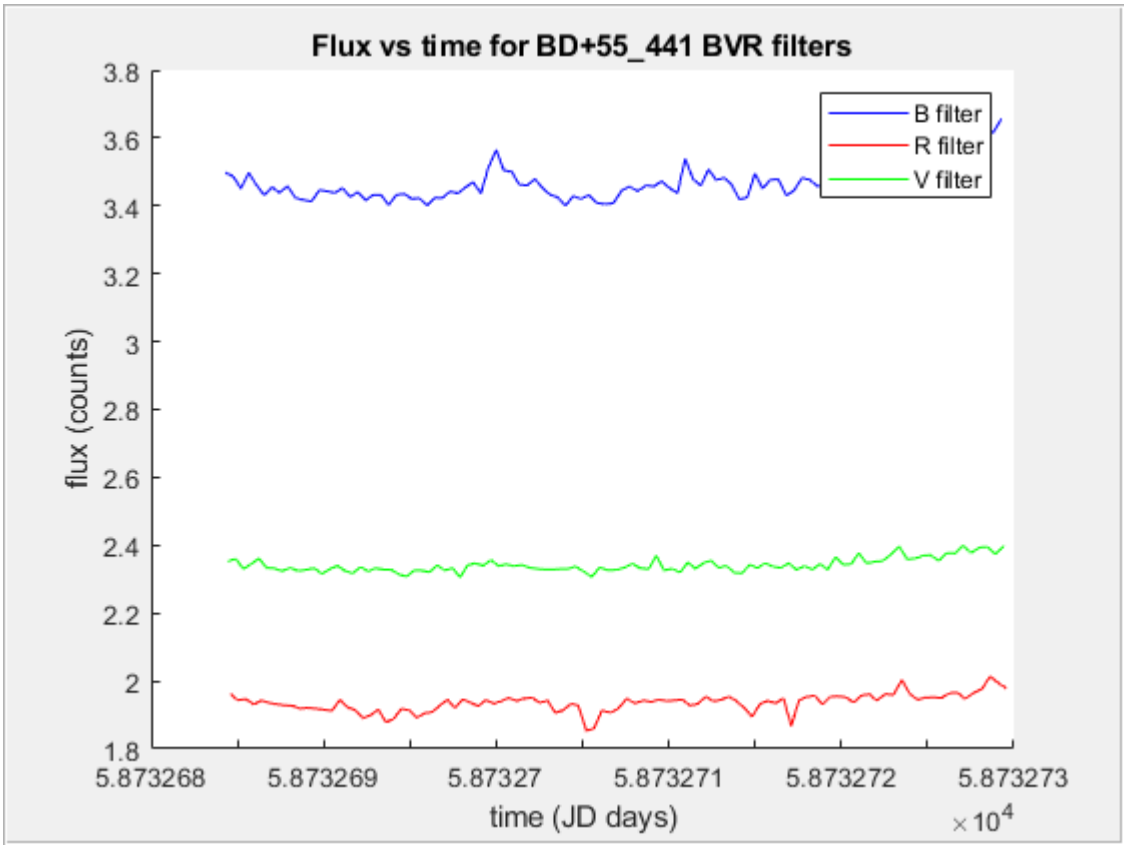
Periodicity between filters

```
hf_sub(2) = figure(2);
hp(2) = uipanel('Parent',hf_sub(2),'Position',[0 0 1 1]);
subplot(3,1,1,'Parent',hp(2));
% plotting in blue because B filter is blue light (~400-500 nm)
plot(BD55_441(:,1),BD55_441(:,2),'*b')
title('Flux vs time for BD+55\_441 B filter, Data Points');
xlabel('time (JD days)');
ylabel('flux (counts)');
subplot(3,1,2,'Parent',hp(2));
% plotting in red because R filter is red light (~550-800 nm)
```

```
plot(BD55_441(:,3),BD55_441(:,4),'*r');
title('Flux vs time for BD+55\_441 R filter, Data Points');
xlabel('time (JD days)');
ylabel('flux (counts)');
subplot(3,1,3,'Parent',hp(2));
% plotting green but V filter is visible light (~500-700 nm)
plot(BD55_441(:,5),BD55_441(:,6),'*g');
title('Flux vs time for BD+55\_441 V filter, Data Points');
xlabel('time (JD days)');
ylabel('flux (counts)');
```



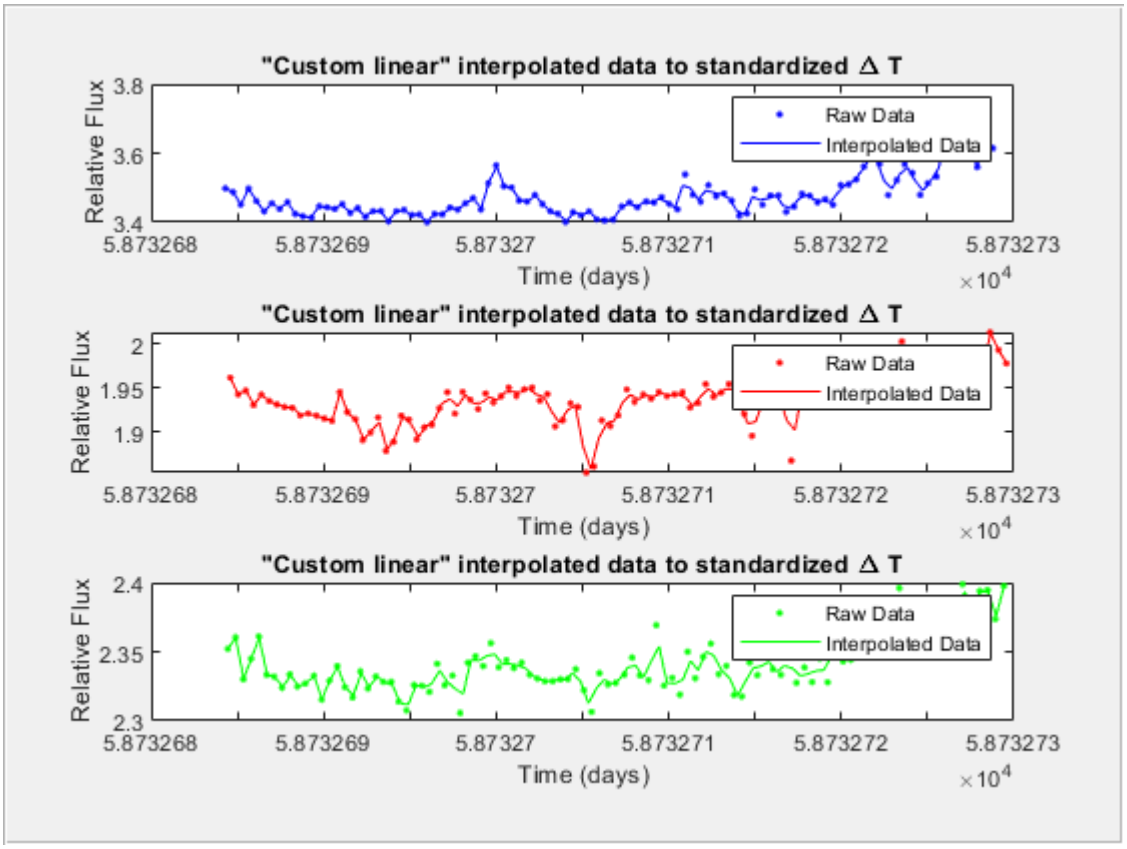

```
hf_sub(3) = figure(3);
hp(3) = uipanel('Parent',hf_sub(3),'Position',[0 0 1 1]);
subplot(1,1,1,'Parent',hp(3))
hold on
plot(BD55_441(:,1),BD55_441(:,2), 'b')
plot(BD55_441(:,3),BD55_441(:,4), 'r')
plot(BD55_441(:,5),BD55_441(:,6), 'g')
hold off
title('Flux vs time for BD+55\_441 BVR filters');
xlabel('time (JD days)');
legend('B filter', 'R filter', 'V filter');
ylabel('flux (counts)');
```



Interpolation investigation

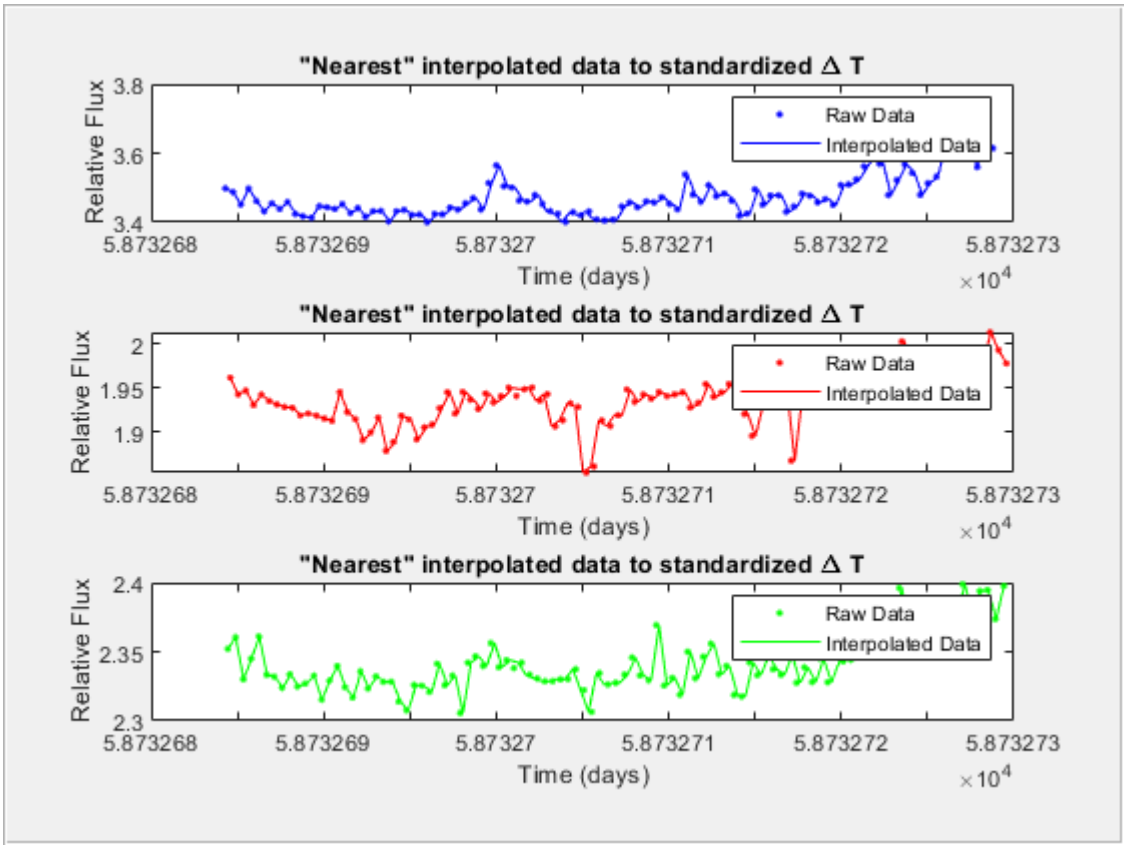
custom linear

```
hf_sub(4) = figure(4);
hp(4) = uipanel('Parent',hf_sub(4),'Position',[0 0 1 1]);
subplot(3,1,1,'Parent',hp(4));
[Tnew,Mnew] = Interp_Lin(BD55_441(1:100,1),BD55_441(1:100,2));
plot(BD55_441(1:100,1),BD55_441(1:100,2),'.b',Tnew,Mnew,'b');
title('"Custom linear" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
subplot(3,1,2,'Parent',hp(4));
[Tnew,Mnew] = Interp_Lin(BD55_441(1:100,3),BD55_441(1:100,4));
plot(BD55_441(1:100,3),BD55_441(1:100,4),'.r',Tnew,Mnew,'r');
title('"Custom linear" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
subplot(3,1,3,'Parent',hp(4));
[Tnew,Mnew] = Interp_Lin(BD55_441(1:100,5),BD55_441(1:100,6));
plot(BD55_441(1:100,5),BD55_441(1:100,6),'.g',Tnew,Mnew,'g');
title('"Custom linear" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
```



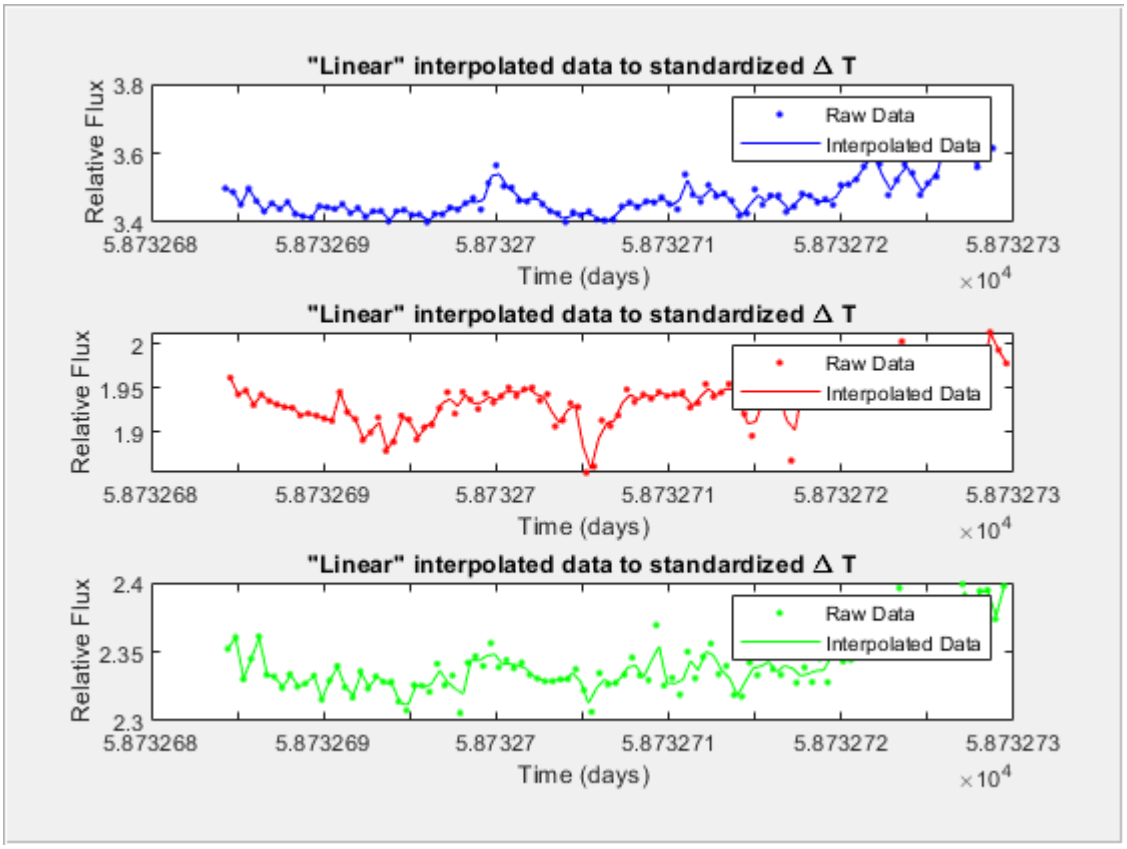
Nearest

```
hf_sub(5) = figure(5);
hp(5) = uipanel('Parent',hf_sub(5),'Position',[0 0 1 1]);
subplot(3,1,1,'Parent',hp(5));
[Tnew,Mnew] = Interp_nearest(BD55_441(2:100,1),BD55_441(2:100,2));
plot(BD55_441(1:100,1),BD55_441(1:100,2),'.b',Tnew,Mnew,'b');
title('"Nearest" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
subplot(3,1,2,'Parent',hp(5));
[Tnew,Mnew] = Interp_nearest(BD55_441(1:100,3),BD55_441(1:100,4));
plot(BD55_441(1:100,3),BD55_441(1:100,4),'.r',Tnew,Mnew,'r');
title('"Nearest" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
subplot(3,1,3,'Parent',hp(5));
[Tnew,Mnew] = Interp_nearest(BD55_441(1:100,5),BD55_441(1:100,6));
plot(BD55_441(1:100,5),BD55_441(1:100,6),'.g',Tnew,Mnew,'g');
title('"Nearest" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
```



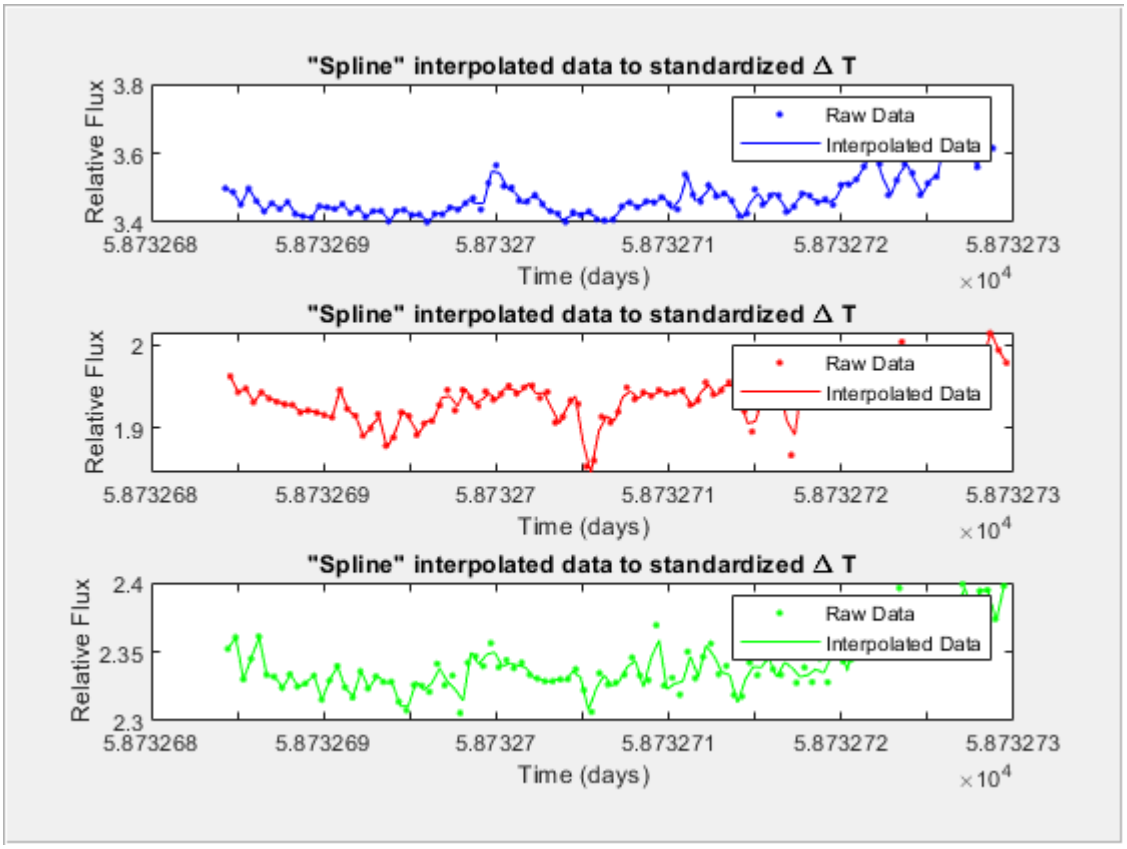
linear

```
hf_sub(6) = figure(6);
hp(6) = uipanel('Parent',hf_sub(6),'Position',[0 0 1 1]);
subplot(3,1,1,'Parent',hp(6));
[Tnew,Mnew] = Interp_linear(BD55_441(2:100,1),BD55_441(2:100,2));
plot(BD55_441(1:100,1),BD55_441(1:100,2),'.b',Tnew,Mnew,'b');
title('"Linear" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
subplot(3,1,2,'Parent',hp(6));
[Tnew,Mnew] = Interp_linear(BD55_441(1:100,3),BD55_441(1:100,4));
plot(BD55_441(1:100,3),BD55_441(1:100,4),'.r',Tnew,Mnew,'r');
title('"Linear" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
subplot(3,1,3,'Parent',hp(6));
[Tnew,Mnew] = Interp_linear(BD55_441(1:100,5),BD55_441(1:100,6));
plot(BD55_441(1:100,5),BD55_441(1:100,6),'.g',Tnew,Mnew,'g');
title('"Linear" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
```



spline

```
hf_sub(7) = figure(7);
hp(7) = uipanel('Parent',hf_sub(7),'Position',[0 0 1 1]);
subplot(3,1,1,'Parent',hp(7));
[Tnew,Mnew] = Interp_spline(BD55_441(2:100,1),BD55_441(2:100,2));
plot(BD55_441(1:100,1),BD55_441(1:100,2),'.b',Tnew,Mnew,'b');
title('"Spline" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
subplot(3,1,2,'Parent',hp(7));
[Tnew,Mnew] = Interp_spline(BD55_441(1:100,3),BD55_441(1:100,4));
plot(BD55_441(1:100,3),BD55_441(1:100,4),'.r',Tnew,Mnew,'r');
title('"Spline" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
subplot(3,1,3,'Parent',hp(7));
[Tnew,Mnew] = Interp_spline(BD55_441(1:100,5),BD55_441(1:100,6));
plot(BD55_441(1:100,5),BD55_441(1:100,6),'.g',Tnew,Mnew,'g');
title('"Spline" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
```



polyfit - needs to be conditioned appropriately.

```
hf_sub(8) = figure(8);
hp(8) = uipanel('Parent',hf_sub(8),'Position',[0 0 1 1]);
subplot(3,1,1,'Parent',hp(8));
[Tnew,Mnew] = Interp_polyfit(BD55_441(2:100,1),BD55_441(2:100,2));
```

```
Warning: Polynomial is badly conditioned. Add points with distinct X values, reduce the degree of the
polynomial, or try centering and scaling as described in HELP POLYFIT.
```

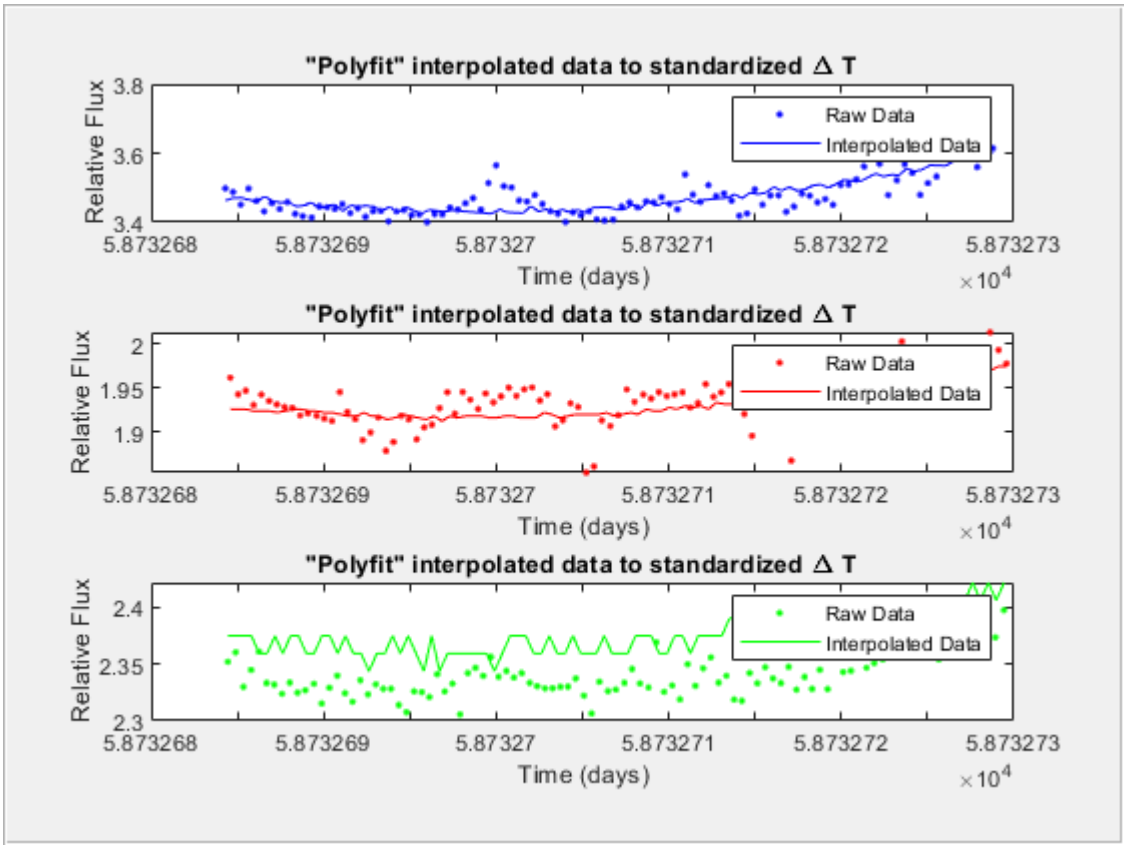
```
plot(BD55_441(1:100,1),BD55_441(1:100,2),'.b',Tnew,Mnew,'b');
title('"Polyfit" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
subplot(3,1,2,'Parent',hp(8));
[Tnew,Mnew] = Interp_polyfit(BD55_441(1:100,3),BD55_441(1:100,4));
```

```
Warning: Polynomial is badly conditioned. Add points with distinct X values, reduce the degree of the
polynomial, or try centering and scaling as described in HELP POLYFIT.
```

```
plot(BD55_441(1:100,3),BD55_441(1:100,4),'.r',Tnew,Mnew,'r');
title('"Polyfit" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
subplot(3,1,3,'Parent',hp(8));
[Tnew,Mnew] = Interp_polyfit(BD55_441(1:100,5),BD55_441(1:100,6));
```

```
Warning: Polynomial is badly conditioned. Add points with distinct X values, reduce the degree of the
polynomial, or try centering and scaling as described in HELP POLYFIT.
```

```
plot(BD55_441(1:100,5),BD55_441(1:100,6),'.g',Tnew,Mnew,'g');
title('"Polyfit" interpolated data to standardized \Delta T');
legend('Raw Data','Interpolated Data');
xlabel('Time (days)');
ylabel('Relative Flux');
```



Input all data

Text files:

```
%BD+48_1098
opts = detectImportOptions("BD+48_1098.txt");
opts.DataLines = 3;
opts.VariableNames = {'B_time','B_flux','R_time','R_flux','V_time','V_flux'};
opts.VariableTypes = {'double','double','double','double','double','double'};
BD48_1098 = rmmissing(readmatrix("BD+55_441.txt",opts)); %the matrix data of the text file
%preview("BD+48_1098.txt",opts)
whos BD48_1098
```

```
  Name            Size            Bytes  Class     Attributes

  BD48_1098      100x6              4800  double
```

```
%HD28497
opts = detectImportOptions("HD28497.txt");
opts.DataLines = 3;
```

```
opts.VariableNames = {'B_time','B_flux','R_time','R_flux','V_time','V_flux'};
opts.VariableTypes = {'double','double','double','double','double','double'};
HD28497 = rmmissing(readmatrix("HD28497.txt",opts)) %the matrix data of the text file
```

```
HD28497 = 600×6
10^4 ×
   5.844163256000000   0.151884039400000   5.844163279000000   0.047485834000000 ···
   5.844163294000000   0.157713255000000   5.844163317000000   0.047850097100000
   5.844163332000000   0.147648080800000   5.844163355000000   0.050717498800000
   5.844163370000000   0.154105058200000   5.844163393000001   0.048745268800000
   5.844163409000000   0.154416998300000   5.844163431999999   0.046480291500000
   5.844163447000000   0.154034530100000   5.844163470000000   0.052878906200000
   5.844163485000000   0.158524561400000   5.844163508000000   0.050080829500000
   5.844163523000000   0.159731365000000   5.844163546000000   0.053844298900000
   5.844163560999999   0.140623476800000   5.844163584000000   0.050871022200000
   5.844163599000000   0.159835953000000   5.844163622000000   0.053311599500000
      ⋮
```

```
%preview("HD28497.txt",opts)
whos HD28497
```

```
  Name           Size            Bytes  Class     Attributes

  HD28497      600x6             28800  double
```

```
%HD46131
opts = detectImportOptions("HD46131.txt");
opts.DataLines = 3;
opts.VariableNames = {'B_time','B_flux','R_time','R_flux','V_time','V_flux'};
opts.VariableTypes = {'double','double','double','double','double','double'};
HD46131 = rmmissing(readmatrix("HD46131.txt",opts)); %the matrix data of the text file
%preview("HD46131.txt",opts)
whos HD46131
```

```
  Name           Size            Bytes  Class     Attributes

  HD46131      250x6             12000  double
```

```
%HD88661
opts = detectImportOptions("HD88661.txt");
opts.DataLines = 3;
opts.VariableNames = {'B_time','B_flux','R_time','R_flux','V_time','V_flux'};
opts.VariableTypes = {'double','double','double','double','double','double'};
HD88661 = rmmissing(readmatrix("HD88661.txt",opts)); %the matrix data of the text file
%preview("HD88661.txt",opts)
whos HD88661
```

```
  Name           Size            Bytes  Class     Attributes

  HD88661      35x6               1680  double
```

```
%HD105521
opts = detectImportOptions("HD105521.txt");
opts.DataLines = 3;
opts.VariableNames = {'B_time','B_flux','R_time','R_flux','V_time','V_flux'};
opts.VariableTypes = {'double','double','double','double','double','double'};
HD105521 = rmmissing(readmatrix("HD105521.txt",opts)); %the matrix data of the text file
```

```
%preview("HD105521.txt",opts)
whos HD105521
```

```
  Name            Size            Bytes  Class     Attributes

  HD105521      180x6              8640  double
```

```
%HD105521
opts = detectImportOptions("HD105521.txt");
opts.DataLines = 3;
opts.VariableNames = {'B_time','B_flux','R_time','R_flux','V_time','V_flux'};
opts.VariableTypes = {'double','double','double','double','double','double'};
HD105521 = rmmissing(readmatrix("HD105521.txt",opts)); %the matrix data of the text file
%preview("HD105521.txt",opts)
whos HD105521
```

```
  Name            Size            Bytes  Class     Attributes

  HD105521      180x6              8640  double
```

CSV files

```
%HD106306
%B_filter
opts = detectImportOptions('HD106306_B.csv');
opts.DataLines = [2 Inf];
All_fields_available = opts.VariableNames;
opts.SelectedVariableNames = {'J_D__2400000','rel_flux_T1'};
%preview("HD106306_B.csv",opts)
HD106306_B = readmatrix("HD106306_B.csv",opts);

%R_filter
opts = detectImportOptions('HD106306_R.csv');
opts.DataLines = [2 Inf];
All_fields_available = opts.VariableNames;
opts.SelectedVariableNames = {'J_D__2400000','rel_flux_T1'};
%preview("HD106306_R.csv",opts)
HD106306_R = readmatrix("HD106306_R.csv",opts);

%V_filter
opts = detectImportOptions('HD106306_V.csv');
opts.DataLines = [2 Inf];
All_fields_available = opts.VariableNames;
opts.SelectedVariableNames = {'J_D__2400000','rel_flux_T1'};
%preview("HD106306_V.csv",opts)
HD106306_V = readmatrix("HD106306_V.csv",opts);

HD106306 = rmmissing([HD106306_B HD106306_R HD106306_V]); %the matrix data of the text file
whos HD106306
```

```
  Name            Size            Bytes  Class     Attributes

  HD106306      100x6              4800  double
```

```
%HD147302
%B_filter
```

```
opts = detectImportOptions('HD147302_B.csv');
opts.DataLines = [2 Inf];
All_fields_available = opts.VariableNames;
opts.SelectedVariableNames = {'J_D__2400000','rel_flux_T1'};
%preview("HD147302_B.csv",opts)
HD147302_B = readmatrix("HD147302_B.csv",opts);

%R_filter
opts = detectImportOptions('HD147302_R.csv');
opts.DataLines = [2 Inf];
All_fields_available = opts.VariableNames;
opts.SelectedVariableNames = {'J_D__2400000','rel_flux_T1'};
%preview("HD147302_R.csv",opts)
HD147302_R = readmatrix("HD147302_R.csv",opts);

%V_filter
opts = detectImportOptions('HD147302_V.csv');
opts.DataLines = [2 Inf];
All_fields_available = opts.VariableNames;
opts.SelectedVariableNames = {'J_D__2400000','rel_flux_T1'};
%preview("HD147302_V.csv",opts)
HD147302_V = readmatrix("HD147302_V.csv",opts);

HD147302 = rmmissing([HD147302_B HD147302_R HD147302_V]); %the matrix data of the text file
whos HD147302
```

```
  Name            Size            Bytes  Class     Attributes

  HD147302      100x6              4800  double
```

HD152060 and HD209522 can't be described in the same form as the others. Will investigate

Important Interpolation Functions

There are two different linear interpolation functions - the first is without built-in functions and the other is built-in. The results from both funcitons are similar.

Other interpolation methods are displayed.

Custom functions

```
function [Tnew,Mnew] = Interp_Lin(T,M)
    %This is Joe's custom linear interpolation:
    %----

    % --Sum all of the time differences between measurements--
    n = numel(T);
    sum = 0;
    for l = 1:n-1
        sum = sum + abs(T(l+1) - T(l));
    end

    % --Find averaged time scale--
```

```
    avg_dT = sum / (n-1);
    Tnew = T(1):avg_dT:T(n);

    % --Calculate Mnew values--
    m = numel(Tnew);
    Mnew = zeros(1,m);

    Mnew(1) = M(1);
    Mnew(m) = M(n);

    for l = 2:m-1
        for k = 1:n
           if T(k) <= Tnew(l)
               if Tnew(l) <= T(k+1)
                   Mnew(l) = (M(k+1) - M(k))./(T(k+1) - T(k)).*(Tnew(l)-T(k)) + M(k);
                   %eq for a line. i.e. y = mx + b
               end
           end
        end
    end

end
```

Various built-in Matlab Functions

```
function [Tnew,Mnew] = Interp_nearest(T,M)
    %This uses the built-in function 'interp1' with method 'nearest'
    %----

    % --Sum all of the time differences between measurements--
    n = numel(T);
    sum = 0;
    for l = 1:n-1
        sum = sum + abs(T(l+1) - T(l));
    end

    % --Find averaged time scale--
    avg_dT = sum / (n-1);
    Tnew = T(1):avg_dT:T(n);

    % --Calculate Mnew values--
    Mnew = interp1(T,M,Tnew,'nearest');
end
```

```
function [Tnew,Mnew] = Interp_linear(T,M)
    %This uses the built-in function 'interp1' with method 'linear'
    %----

    % --Sum all of the time differences between measurements--
    n = numel(T);
    sum = 0;
    for l = 1:n-1
```

```
        sum = sum + abs(T(l+1) - T(l));
    end

    % --Find averaged time scale--
    avg_dT = sum / (n-1);
    Tnew = T(1):avg_dT:T(n);

    %--Calculate Mnew values--
    Mnew = interp1(T,M,Tnew,'linear');
end
```

```
function [Tnew,Mnew] = Interp_spline(T,M)
    %This uses the built-in function 'interp1' with method 'spline'
    %----

    % --Sum all of the time differences between measurements--
    n = numel(T);
    sum = 0;
    for l = 1:n-1
        sum = sum + abs(T(l+1) - T(l));
    end

    % --Find averaged time scale--
    avg_dT = sum / (n-1);
    Tnew = T(1):avg_dT:T(n);

    % --Calculate Mnew values--
    Mnew = interp1(T,M,Tnew,'spline');
end
```

```
function [Tnew,Mnew] = Interp_polyfit(T,M)
    %This uses the built-in function 'interp1' with method 'polyfit'
    %----

    % --Sum all of the time differences between measurements--
    n = numel(T);
    sum = 0;
    for l = 1:n-1
        sum = sum + abs(T(l+1) - T(l));
    end

    % --Find averaged time scale--
    avg_dT = sum / (n-1);
    Tnew = T(1):avg_dT:T(n);

    % --Calculate Mnew values--
    n = numel(T);
    p = polyfit(T,M,5);
    Mnew = polyval(p,Tnew);
```

```
end
```