Table of Contents

```
%Ben Ausburn
%Lab 1
```

ALUMINUM

```
clear all
close all
clc

load('specimen.dat')

y  = specimen(1:467,2);   %Force
x  = specimen(1:467,3);   %Strain (extensiometer reading)
xF = specimen(1:761,1);   %Axial Displacement from Force Grips
yF = specimen(1:761,2);   %Force (made with same dimensions as FG)
```

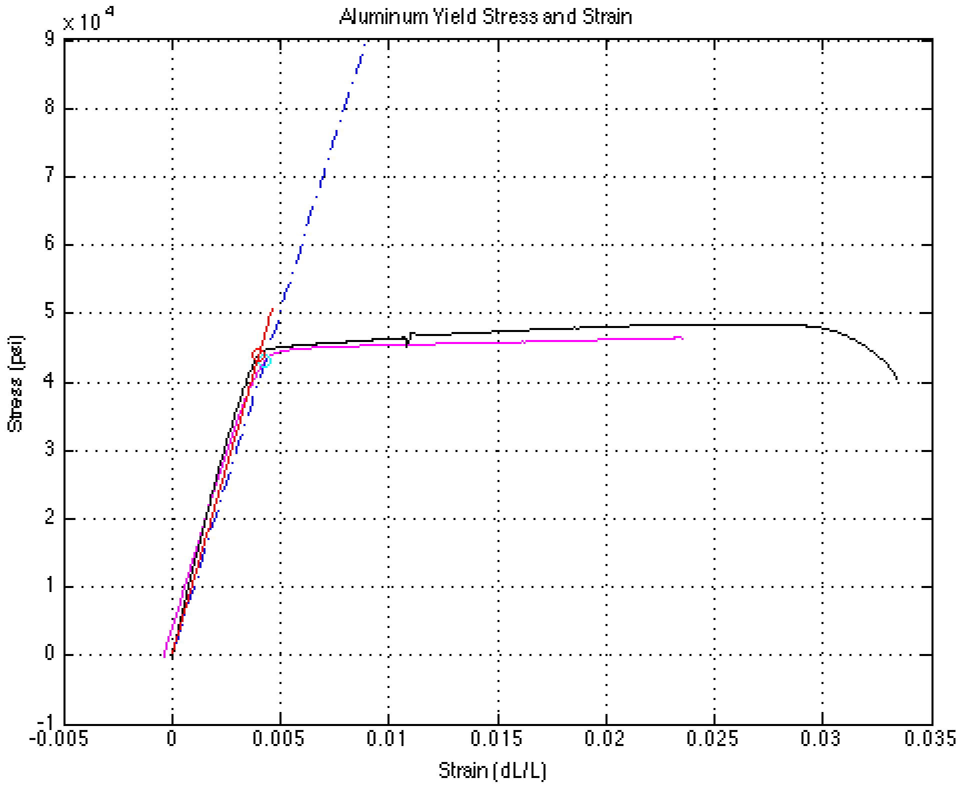
Area Uncertainty

```
syms w t

Area = w*t;       %in^2

u_t = .00025;     %uncertainty of thickness (in)
u_w = .00025;     %uncertainty of width (in)

u_Area = sqrt((diff(Area,t)*u_t)^2+(diff(Area,w)*u_w)^2);

t = .076; %in
w = .365; %in
```

```
Area   = subs(Area)     %Area
u_Area = subs(u_Area)   %Percent Uncertain

%%%%%%%%%%%%%%%%%%% GRAPHING %%%%%%%%%%%%%%%%%%%%%%
figure(1)
Sa = y ./ Area;                %Stress
eslope = (Sa(100,1)-Sa(50,1)) ./ (specimen(100,3)-specimen(50,3)); %slope of linea

L1 = eslope .* specimen(1:100);

plot(x,Sa,'-m');hold on              %Stress vs Strain

title('Aluminum Yield Stress and Strain'); %Graph formatting
xlabel('Strain (dL/L)');
ylabel('Stress (psi)');
grid on
axis([-.005 .035 -1*10E3 9*10E3])
L2 = L1*.998;    % .2% offset

plot(specimen(1:100) , L2,'-.b');hold on   % .2% offset
%%%%% Finding .2% offset intersection (yield point) %%%%%
y1  = Sa(166:400);
y2  = transpose(specimen(166:400) .* .998 .* eslope);
idx = find(abs(y1 - y2) == min(abs(y1 - y2)));
iy = y1(idx)                   %finds y intercept
ix = iy ./ (eslope .* .998)     %finds corresponding x intercept

plot(ix , iy ,'oc');hold on     %Plotting the yield point

%%%%%%%%%%%%%%%%%%%%%%%% GRAPHING 2 %%%%%%%%%%%%%%%%%%%%%
L0  = 6.5;                %initial length (in)
SaF = yF ./ Area;         %converting to (psi)
xx  = xF ./ L0;           %Strain from force grips (dimensionless)

plot(xx,SaF,'k');hold on     %plotting strain vs stress

%%%%% slope of linear region with .2 %%%%%
eslopeF = .998 .* (SaF(150,1)-SaF(50,1)) ./ (xx(150,1)-xx(50,1));

L3 = eslopeF .* xx(1:200);

plot(xx(1:200),L3,'-r');hold on

title('Aluminum Yield Stress and Strain'); %Graph formatting
xlabel('Strain (dL/L)');
ylabel('Stress (psi)');
grid on

%%%%% Finding .2% offset intersection (yield point) %%%%%
Y1  = SaF(166:400);
Y2  = (xx(166:400) .* eslopeF);
Idx = find(abs(Y1 - Y2) == min(abs(Y1 - Y2)));
Iy = Y1(Idx)                    %finds y intercept
```

```
Ix = Iy ./ (eslopeF .* .998)     %finds corresponding x intercept

plot(Ix , Iy ,'or');hold on      %Plotting the yield point

%%%%% Finding Uncertainties For Stress and Strain %%%%%
%%%% STRAIN UNCERTAINTY FORCE GRIPS %%%


xxu = xF ./ L0;

u_xF = .01;        %uncertainty of force
u_L0 = (1/64);     %uncertainty of length (in)

%u_xxu = sqrt((diff(xxu,xF)*u_xF).^2+(diff(xxu,L0).*u_L0).^2)

L0  = 6.5;                %initial length (in)
xF = specimen(1:761,1);

xxu   = subs(xxu);     %Array Uncertainty for Strain with Force Grips(FG)
u_xxu = (1./(500000.*6.5.^2) + xF.^2./(4096.*6.5.^4)).^(1/2);   %Uncertainty for S
```

```
Area =

    0.0277


u_Area =

   9.3207e-05


iy =

   4.3066e+04


ix =

    0.0043


Iy =

   4.3975e+04


Ix =

    0.0040
```



STRESS UNCERTAINTY FORCE GRIPS

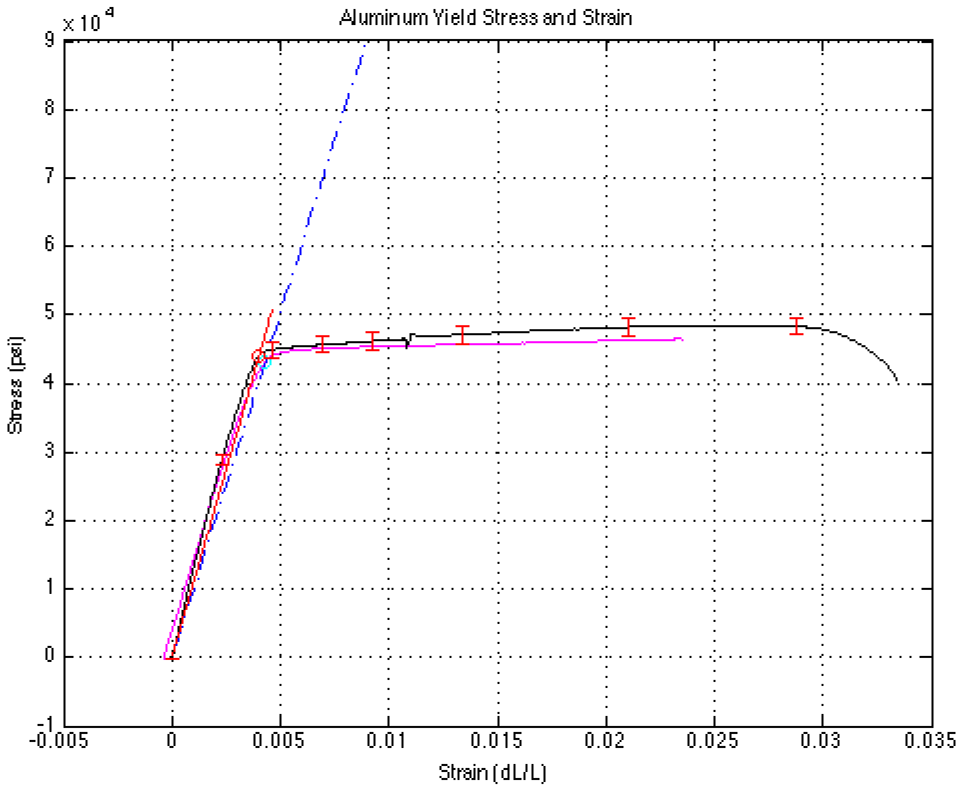
```
syms yF Area

yyu = yF ./ Area;

u_yF  = .01;                %uncertainty of force
cArea = u_Area .* 100;      %uncertainty of Area (in)

u_yyu = sqrt((diff(yyu,yF)*u_yF)^2+(diff(yyu,Area)*cArea)^2);

yF   = specimen(1:761,2);   %Force
Area = .1               ;   %area

yyu   = subs(yyu);      %Array Uncertainty for Stress with FG
u_yyu = subs(u_yyu);    %Uncertainty for Stress with FG
```

Decreases the number of data point for a simpler graph %%%

```
u_yyu2 = u_yyu(1:100:761);
xx2    = xx(1:100:761);
SaF    = SaF(1:100:761);
xxu2 = u_xxu(1:100:761);
```

PLOTTING ERRORBARS ON GRAPH

```
errorbar(xx2,SaF,u_yyu2,'.r');hold on
%herrorbar(xx2,SaF,xxu2,'.r');hold on
```



ULTIMATE STRESS AND STRAIN

```
UStrain = max(xx2)    %dL/L
UStress = max(SaF)   %psi
%%ASSOCIATED UNCERTAINTY
u_UStress = max(u_xxu)
u_UStrain = max(u_yyu)
```

UStrain =

0.0287

UStress =

4.8318e+04

u_UStress =

```
    2.3189e-04


u_UStrain =

    1.2531e+03
```

RUPTURE STRESS AND STRAIN

```
xF  = specimen(1:761,1);
yf  = specimen(1:761,2);
xx  = xF ./ L0;
SaF = yf ./ Area;
RStrain = max(xx)
RStress = SaF(761)
%%ASSOCIATED UNCERTAINTY%%
u_RStrain  = u_xxu(761)
u_RStress  = u_yyu(761)
```

```
RStrain =

     0.0334


RStress =

    1.1247e+04


u_RStrain =

    2.3189e-04


u_RStress =

    1.0483e+03
```

TRUE RUPTURE STRESS AND STRAIN

```
%%First Finding Area final and its Uncertainty:
syms wf tf
Af = wf*tf; %in^2

u_tf = .00025;    %uncertainty of thickness (in)
u_wf = .00025;    %uncertainty of width (in)

u_Af = sqrt((diff(Af,tf)*u_tf)^2+(diff(Af,wf)*u_wf)^2);
```

```
wf = .310;  %in
tf = .059;  %in

Af   = subs(Af);      %Area final
u_Af = subs(u_Af);    %Percent Uncertain

%%Now Calculating True Rupture Stress%%
yF = specimen(761,2);
TRStress = yF ./ Af

%%UNCERTAINTY OF TRSTRESS%%
syms yF Af1
TRStress = yF ./ Af1;

u_yF  = .005;       %uncertainty of Force (lb)
u_Af1 = u_Af;

u_TRStress = sqrt((diff(TRStress,yF)*u_yF)^2+(diff(TRStress,Af1)*u_Af1)^2);

yF   = specimen(761,2);
Af1  = Af;

TRStress   = subs(TRStress);     %TStress
u_TRStress = subs(u_TRStress)    %Uncertainty of true rupture stress
%%%TRUE RUPTURE STRAIN IS THE SAME AS RUPTURE STRAIN%%%
%THEREFORE I CAN USE THE SAME DATA
RStrain    = max(xx)
u_RStrain  = u_xxu(761)
```

```
TRStress =

   6.1493e+04


u_TRStress =

  265.2422


RStrain =

    0.0334


u_RStrain =

   2.3189e-04
```

PERCENT ELONGATION %%%%%%%%%%%%%%%

```
syms Lf Li
PE = ((Lf-Li)/Li)*100;

u_Lf = (1/64); %(in)
u_Li = (1/64); %(in)

uPE = sqrt((diff(PE,Lf)*u_Lf)^2+(diff(PE,Li)*u_Li)^2);

Lf = 6.6875;
Li = 6.5;

PE   = subs(PE);   %Percent Elongation
uPE  = subs(uPE);  %Uncertainty of Percent Elongation
PE = double(PE)
uPE = double(uPE)
%%%NOTE PERCENT ELEONGATION IS <5% WHICH MEANS ALUMINUM IS DUCTILE%%%
```

```
PE =

    2.8846


uPE =

    0.3449
```

PERCENT AREA REDUCED %%%%%%%%%%%%%%%

```
syms Ai Afi
PAR  = ((Ai-Afi)/Ai)*100;

u_Ai  = u_Area;
u_Afi = u_Af;

uPAR = sqrt((diff(PAR,Ai)*u_Ai)^2+(diff(PAR,Afi)*u_Afi)^2);

Ai  = Area;
Afi = Af;

PAR  = subs(PAR);
uPAR = subs(uPAR);
PAR  = double(PAR)
uPAR = double(uPAR)

%%%%%%%%%%%%%%%%% MODULUS OF ELASTICITY IS ESLOPE %%%%%%%%%%%%%%%%%%%%
```

```
PAR =

   81.7100


uPAR =

    0.0807
```

MODULUS AND UNCERTAINTY OF EXTENSIOMETER%%%%%

```
syms hy ly hx lx

u_hy = .01;
u_ly = .01;
u_hx = .01;
u_lx = .01;

ModEE  = (hy-ly) ./ (hx-lx).* .998;

uModEE = sqrt((diff(ModEE,hy)*u_hy)^2+(diff(ModEE,ly)*u_ly)^2 ...
+(diff(ModEE,lx)*u_lx)^2+(diff(ModEE,hx)*u_hx)^2);

hy = Sa(100,1);
ly = Sa(50,1);
hx = specimen(100,3);
lx = specimen(50,3);

ModEE  = subs(ModEE);     %MODULUS OF ELACTICITY FOR EXTENSIOMETER
uModEE = subs(uModEE);    %UNCERTAINTY OF MODULUS OF ELACTICITY FOR EXT
ModEE  = double(ModEE)
uModEE = double(uModEE)
```

```
ModEE =

   1.0058e+07


uModEE =

   1.0317e+08
```

MODULUS AND UNCERTAINTY OF FORCE GRIPS%%%%%

```
syms hy ly hx lx
```

```
u_hy = .01;
u_ly = .01;
u_hx = .01;
u_lx = .01;

eslopeF = .998 .* (SaF(150,1)-SaF(50,1)) ./ (xx(150,1)-xx(50,1));

ModEF  = (hy-ly) ./ (hx-lx).* .998;

uModEF = sqrt((diff(ModEF,hy)*u_hy)^2+(diff(ModEF,ly)*u_ly)^2 ...
+(diff(ModEF,lx)*u_lx)^2+(diff(ModEF,hx)*u_hx)^2);

hy = SaF(150,1);
ly = SaF(50,1);
hx = xx(150,1);
lx = xx(50,1);

ModEF  = subs(ModEF);     %MODULUS OF ELACTICITY FOR FORCE GRIPS
uModEF = subs(uModEF);    %UNCERTAINTY OF MODULUS OF ELACTICITY FOR FG
ModEF  = double(ModEF)
uModEF = double(uModEF)
```

```
ModEF =

   3.0419e+06


uModEF =

   1.8571e+07
```

MODULUS OF RESILIENCE FOR EXTENSIOMETER %%%%%%%%%%%%%%%%

```
Sa = y ./ Area;
x  = specimen(1:467,3);
n = 467;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSR = w
```

```
MODULUSR =

  813.6465
```

MODULUS OF RESILIENCE FOR FORCE GRIPS %%%%%%%%%%%%%%%%%%

```
yF = specimen(1:467,2);
Sa = yF ./ Area;
n = 467;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSTF = w
```

```
MODULUSTF =

  813.6465
```

MODULUS OF Toughness for Force Grips %% %%%%%%%%%%%%%%%%

```
yF = specimen(1:761,2);
Sa = yF ./ Area;
n = 761;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSTF = w
```

```
MODULUSTF =

   2.5476e+03
```

POISSON'S RATIO

```
%%TRANSVERSE STRAIN AND ITS UNCERTAINTY%%%
syms it ft
ea = (ft-it)/it;

u_it = .00025; %(in)
u_ft = .00025; %(in)

u_ea = sqrt((diff(ea,it)*u_it)^2+(diff(ea,ft)*u_ft)^2);
```

```
ft = .059; %(in)
it = .076;%(in)

ea   = subs(ea);
u_ea = subs(u_ea);
ea   = double(ea)
u_ea = double(u_ea)
```

```
ea =

   -0.2237


u_ea =

    0.0042
```

AXIAL STRAIN AND ITS UNCERTAINTY

```
syms il fl
et = (fl-il)/il;

u_il = (1/64); %(in)
u_fl = (1/64); %(in)

u_et = sqrt((diff(et,il)*u_il)^2+(diff(et,fl)*u_fl)^2);

fl = 6.6875; %(in)
il = 6.5;    %(in)

et   = subs(et);
u_et = subs(u_et);
et   = double(et)
u_et = double(u_et)
```

```
et =

    0.0288


u_et =

    0.0034
```

NOW FINDING POISSON'S RATIO AND UNCERTAINTY

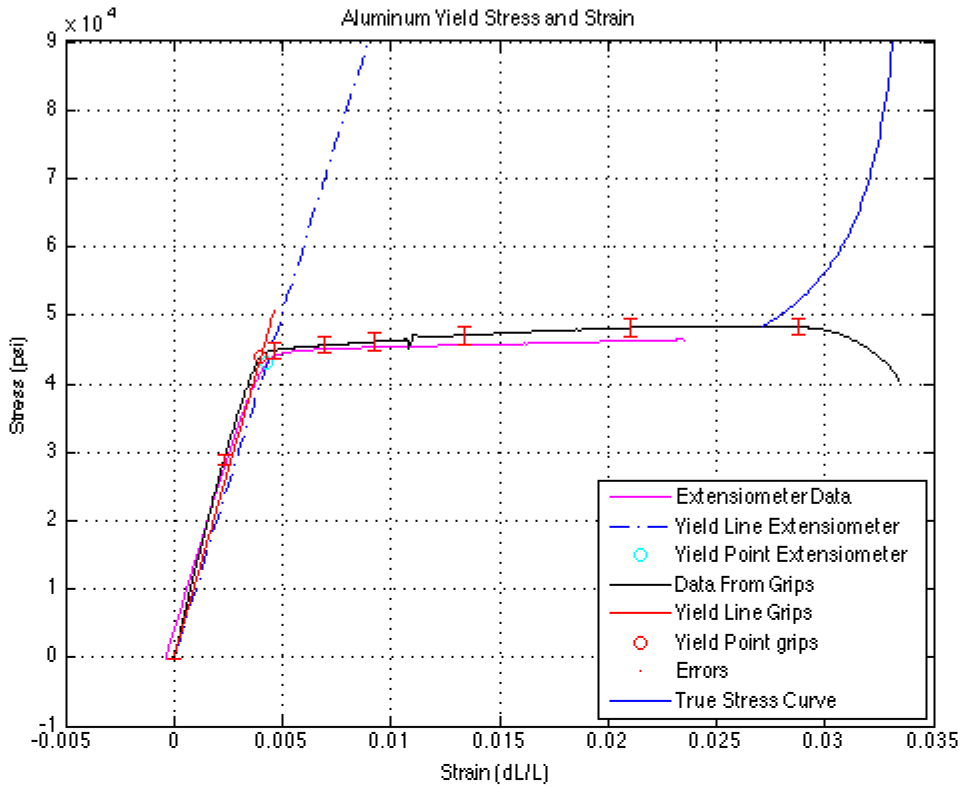
```
syms ea1 et1
```

```
PR = -et1/ea1; %poission's ratio

u_PR = sqrt((diff(PR,ea1)*u_ea)^2+(diff(PR,et1)*u_ea)^2);

ea1 = ea;
et1 = et;


PR   = subs(PR);
u_PR = subs(u_PR);
PR   = double(PR)
u_PR = double(u_PR)
```

```
PR =

    0.1290


u_PR =

    0.0188
```

GRAPHING ULTIMATE STRESS CURVE%%%% %%%

```
Inc = (Ai-Af)./(761-680);
Ar1 = [Ai:-Inc:Af];
Ar3 = Ar1';
Ar4 = specimen(680:761,2);
Ar2 = (Ar4./Ar3)+35000;
plot(xx(680:761),Ar2); hold on


leg1 = legend('Extensiometer Data','Yield Line Extensiometer' ...
    ,'Yield Point Extensiometer','Data From Grips','Yield Line Grips' ...
    ,'Yield Point grips','Errors','True Stress Curve');
set(leg1,'Location','SouthEast')
```

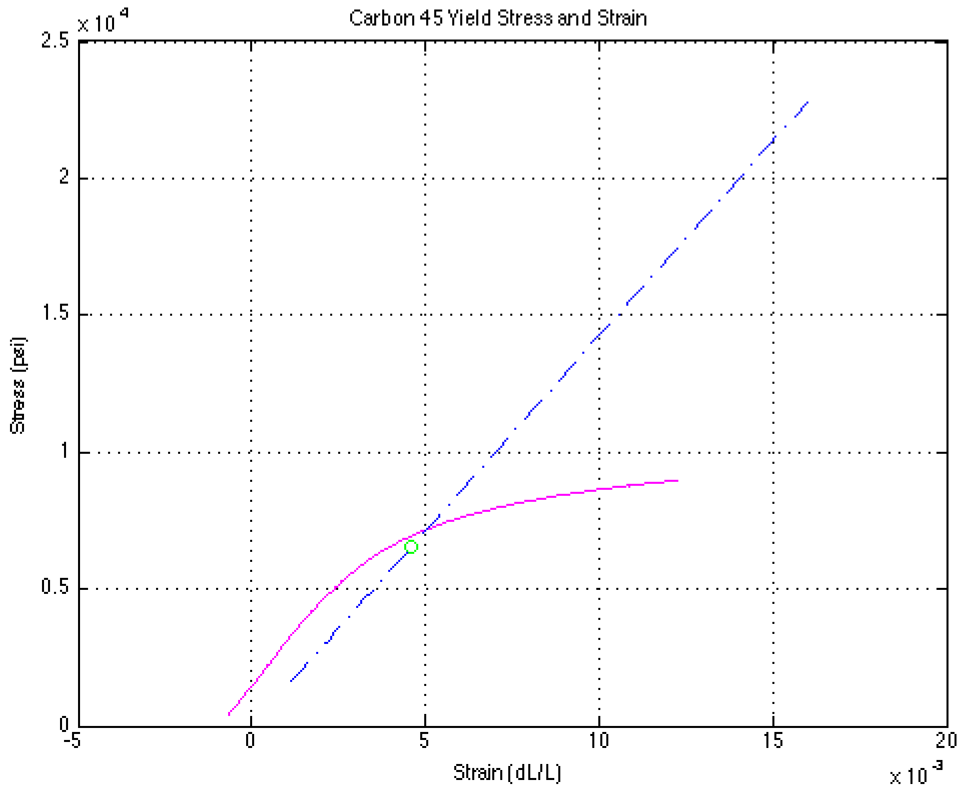


CARBON FIBER 45

```
clear all
close all
clc

load('carbon45.dat')
y  = carbon45(1:459,2);     %Force
x  = carbon45(1:459,3);     %Strain (extensiometer reading)
xF = carbon45(1:1070,1);    %Axial Displacement from Force Grips
yF = carbon45(1:1070,2);    %Force (made with same dimensions as FG)

%%%%%Area Uncertainty%%%%%
syms w t

Area = w*t;       %in^2

u_t = .00025;     %uncertainty of thickness (in)
u_w = .00025;     %uncertainty of width (in)

u_Area = sqrt((diff(Area,t)*u_t)^2+(diff(Area,w)*u_w)^2);

t = .068; %in
w = .742; %in
```

```
Area   = subs(Area)     %Area
u_Area = subs(u_Area)   %Percent Uncertain

%%%%%%%%%%%%%%%%%%% GRAPHING %%%%%%%%%%%%%%%%%%%%%%
figure(1)
Sa = y ./ Area;                 %Stress
eslope = (Sa(100,1)-Sa(50,1)) ./ (carbon45(100,3)-carbon45(50,3)); %slope of linea

L1 = eslope .* carbon45(1:100);

plot(x,Sa,'-m');hold on              %Stress vs Strain

title('Carbon 45 Yield Stress and Strain'); %Graph formatting
xlabel('Strain (dL/L)');
ylabel('Stress (psi)');
grid on
L2 = L1*.998;    % .2% offset

plot(carbon45(1:100) , L2,'-.b');hold on   % .2% offset
%%%%% Finding .2% offset intersection (yield point) %%%%%
y1  = Sa(166:400);
y2  = transpose(carbon45(166:400) .* .998 .* eslope);
idx = find(abs(y1 - y2) == min(abs(y1 - y2)));
iy = y1(idx)                     %finds y intercept
ix = iy ./ (eslope .* .998)      %finds corresponding x intercept

plot(ix , iy ,'og');hold on      %Plotting the yield point
```

```
Area =

    0.0505


u_Area =

   1.8628e-04


iy =

   6.5637e+03


ix =

    0.0046
```



GRAPHING 2

```
L0  = 6;                   %initial length (in)
SaF = yF ./ Area;            %converting to (psi)
xx  = xF ./ L0;              %Strain from force grips (dimensionless)

plot(xx,SaF,'k');hold on      %plotting strain vs stress

%%%%% slope of linear region with .2 %%%%%
eslopeF = .998 .* (SaF(150,1)-SaF(50,1)) ./ (xx(150,1)-xx(50,1));

L3 = eslopeF .* xx(1:200);

plot(xx(1:200),L3,'-r');hold on

title('Carbon 45 Yield Stress and Strain'); %Graph formatting
xlabel('Strain (dL/L)');
ylabel('Stress (psi)');
grid on

%%%%% Finding .2% offset intersection (yield point) %%%%%
Y1  = SaF(166:400);
Y2  = (xx(166:400) .* eslopeF);
Idx = find(abs(Y1 - Y2) == min(abs(Y1 - Y2)));
Iy = Y1(Idx)                         %finds y intercept
```

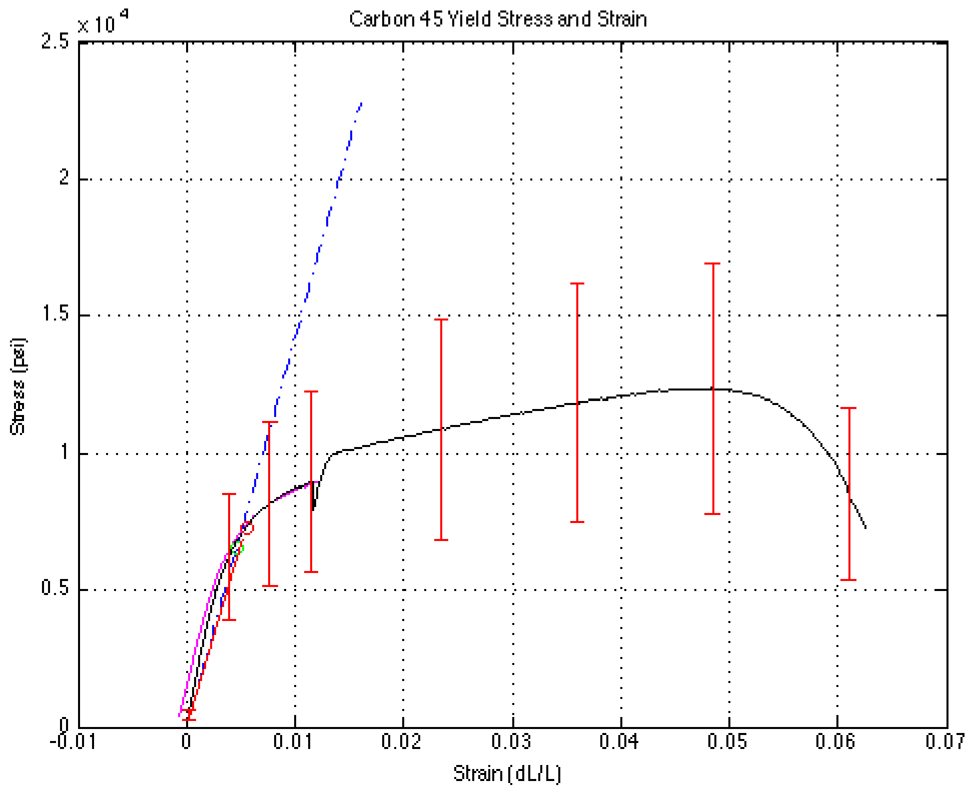
```
Ix = Iy ./ (eslopeF .* .998)     %finds corresponding x intercept

plot(Ix , Iy ,'or');hold on      %Plotting the yield point

%%%%% Finding Uncertainties For Stress and Strain %%%%%
%%%% STRAIN UNCERTAINTY FORCE GRIPS %%%

xxu = xF ./ L0;

u_xF = .01;        %uncertainty of force
u_L0 = (1/64);     %uncertainty of length (in)

%u_xxu = sqrt((diff(xxu,xF)*u_xF).^2+(diff(xxu,L0).*u_L0).^2)

L0  = 6.5;                %initial length (in)
xF = carbon45(1:1070,1);

xxu   = subs(xxu);      %Array Uncertainty for Strain with Force Grips(FG)
u_xxu = (1./(500000.*6.5.^2) + xF.^2./(4096.*6.5.^4)).^(1/2);   %Uncertainty for S

%%%% STRESS UNCERTAINTY FORCE GRIPS %%%
syms yF Area

yyu = yF ./ Area;

u_yF  = .01;                %uncertainty of force
cArea = u_Area .* 100;     %uncertainty of Area (in)

u_yyu = sqrt((diff(yyu,yF)*u_yF)^2+(diff(yyu,Area)*cArea)^2);

yF   = carbon45(1:1070,2);   %Force
Area = .0505            ;   %area

yyu   = subs(yyu);      %Array Uncertainty for Stress with FG
u_yyu = subs(u_yyu);   %Uncertainty for Stress with FG
```

Decreases the number of data point for a simpler graph %%%

```
u_yyu2 = u_yyu(1:150:1070);
xx2    = xx(1:150:1070);
SaF   = SaF(1:150:1070);
xxu2 = u_xxu(1:150:1070);

%%%%%%%%%% PLOTTING ERRORBARS ON GRAPH %%%%%%%%%%
errorbar(xx2,SaF,u_yyu2,'.r');hold on
%herrorbar(xx2,SaF,xxu2,'.r');hold on
```

```
Iy =

   7.2900e+03
```

```
Ix =

    0.0055
```



ULTIMATE STRESS AND STRAIN

```
UStrain = max(xx2)     %dL/L
UStress = max(SaF)    %psi
%%ASSOCIATED UNCERTAINTY
u_UStress = max(u_xxu)
u_UStrain = max(u_yyu)
```

```
UStrain =

    0.0610


UStress =

   1.2348e+04
```

```
u_UStress =

   2.5808e-04


u_UStrain =

   4.5534e+03
```

RUPTURE STRESS AND STRAIN

```
xF  = carbon45(1:1070,1);
yf  = carbon45(1:1070,2);
xx  = xF ./ L0;
SaF = yf ./ Area;
RStrain = max(xx)
RStress = SaF(1070)
%%ASSOCIATED UNCERTAINTY%%
u_RStrain  = u_xxu(1070)
u_RStress  = u_yyu(1070)
```

```
RStrain =

    0.0577


RStress =

   7.2614e+03


u_RStrain =

   2.5808e-04


u_RStress =

   2.6785e+03
```

TRUE RUPTURE STRESS AND STRAIN

```
%%First Finding Area final and its Uncertainty:
syms wf tf
Af = wf*tf; %in^2

u_tf = .00025;    %uncertainty of thickness (in)
u_wf = .00025;    %uncertainty of width (in)
```

```
u_Af = sqrt((diff(Af,tf)*u_tf)^2+(diff(Af,wf)*u_wf)^2);

wf = .570;  %in
tf = .045;  %in

Af   = subs(Af);     %Area final
u_Af = subs(u_Af);   %Percent Uncertain

%%Now Calculating True Rupture Stress%%
yF = carbon45(1070,2);
TRStress = yF ./ Af

%%UNCERTAINTY OF TRSTRESS%%
syms yF Af1
TRStress = yF ./ Af1;

u_yF  = .005;      %uncertainty of Force (lb)
u_Af1 = u_Af;

u_TRStress = sqrt((diff(TRStress,yF)*u_yF)^2+(diff(TRStress,Af1)*u_Af1)^2);

yF   = carbon45(1070,2);
Af1  = Af;

TRStress   = subs(TRStress);     %TStress
u_TRStress = subs(u_TRStress)    %Uncertainty of true rupture stress
%%%TRUE RUPTURE STRAIN IS THE SAME AS RUPTURE STRAIN%%%
%THEREFORE I CAN USE THE SAME DATA
RStrain    = max(xx)
u_RStrain  = u_xxu(1070)
```

```
        TRStress =

           1.4296e+04


        u_TRStress =

           79.6714


        RStrain =

            0.0577


        u_RStrain =

           2.5808e-04
```

PERCENT ELONGATION

```
syms Lf Li
PE = ((Lf-Li)/Li)*100;

u_Lf = (1/64); %(in)
u_Li = (1/64); %(in)

uPE = sqrt((diff(PE,Lf)*u_Lf)^2+(diff(PE,Li)*u_Li)^2);

Lf = 6+(13/16);  %in
Li = 6;          %in

PE   = subs(PE);   %Percent Elongation
uPE  = subs(uPE);  %Uncertainty of Percent Elongation
PE  = double(PE)
uPE = double(uPE)
%%%NOTE PERCENT ELEONGATION IS <5% WHICH MEANS ALUMINUM IS DUCTILE%%%
```

```
PE =

   13.5417


uPE =

    0.3940
```

PERCENT AREA REDUCED

```
syms Ai Afi
PAR  = ((Ai-Afi)/Ai)*100;

u_Ai  = u_Area;
u_Afi = u_Af;

uPAR = sqrt((diff(PAR,Ai)*u_Ai)^2+(diff(PAR,Afi)*u_Afi)^2);

Ai  = Area;
Afi = Af;

PAR  = subs(PAR);
uPAR = subs(uPAR);
PAR  = double(PAR)
uPAR = double(uPAR)
```

```
PAR =

   49.2079
```

```
uPAR =

    0.3394
```

MODULUS OF ELASTICITY IS ESLOPE

```
%%%%%MODULUS AND UNCERTAINTY OF EXTENSIOMETER%%%%%
syms hy ly hx lx

u_hy = .01;
u_ly = .01;
u_hx = .01;
u_lx = .01;

ModEE  = (hy-ly) ./ (hx-lx).* .998;

uModEE = sqrt((diff(ModEE,hy)*u_hy)^2+(diff(ModEE,ly)*u_ly)^2 ...
+(diff(ModEE,lx)*u_lx)^2+(diff(ModEE,hx)*u_hx)^2);

hy = Sa(100,1);
ly = Sa(50,1);
hx = carbon45(100,3);
lx = carbon45(50,3);

ModEE  = subs(ModEE);     %MODULUS OF ELACTICITY FOR EXTENSIOMETER
uModEE = subs(uModEE);    %UNCERTAINTY OF MODULUS OF ELACTICITY FOR EXT
ModEE  = double(ModEE)
uModEE = double(uModEE)
```

```
ModEE =

   1.4250e+06


uModEE =

   1.4557e+07
```

MODULUS AND UNCERTAINTY OF FORCE GRIPS

```
syms hy ly hx lx
u_hy = .01;
u_ly = .01;
u_hx = .01;
u_lx = .01;
```

```
eslopeF = .998 .* (SaF(150,1)-SaF(50,1)) ./ (xx(150,1)-xx(50,1));

ModEF  = (hy-ly) ./ (hx-lx).* .998;

uModEF = sqrt((diff(ModEF,hy)*u_hy)^2+(diff(ModEF,ly)*u_ly)^2 ...
+(diff(ModEF,lx)*u_lx)^2+(diff(ModEF,hx)*u_hx)^2);

hy = SaF(150,1);
ly = SaF(50,1);
hx = xx(150,1);
lx = xx(50,1);

ModEF  = subs(ModEF);     %MODULUS OF ELACTICITY FOR FORCE GRIPS
uModEF = subs(uModEF);    %UNCERTAINTY OF MODULUS OF ELACTICITY FOR FG
ModEF  = double(ModEF)
uModEF = double(uModEF)
```

```
ModEF =

   1.4376e+06


uModEF =

   8.7911e+06
```

MODULUS OF RESILIENCE FOR EXTENSIOMETER

```
Sa = y ./ Area;
x  = carbon45(1:459,3);
n = 459;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSR = w
```

```
MODULUSR =

  538.1039
```

MODULUS OF RESILIENCE FOR FORCE GRIPS

```
yF = carbon45(1:459,2);
Sa = yF ./ Area;
```

```
n = 459;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSTF = w
```

```
MODULUSTF =

  538.1039
```

MODULUS OF Toughness for Force Grips

```
yF = carbon45(1:1070,2);
Sa = yF ./ Area;
n = 1070;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSTF = w
```

```
MODULUSTF =

   3.2923e+03
```

POISSON'S RATIO

```
%%%TRANSVERSE STRAIN AND ITS UNCERTAINTY%%%
syms it ft
ea = (ft-it)/it;

u_it = .00025; %(in)
u_ft = .00025; %(in)

u_ea = sqrt((diff(ea,it)*u_it)^2+(diff(ea,ft)*u_ft)^2);

ft = .045; %(in)
it = .068;%(in)

ea   = subs(ea);
u_ea = subs(u_ea);
ea   = double(ea)
u_ea = double(u_ea)

%%%AXIAL STRAIN AND ITS UNCERTAINTY%%%
syms il fl
```

```
et = (fl-il)/il;

u_il = (1/64); %(in)
u_fl = (1/64); %(in)

u_et = sqrt((diff(et,il)*u_il)^2+(diff(et,fl)*u_fl)^2);

fl = 6+(13/16); %(in)
il = 6;    %(in)

et   = subs(et);
u_et = subs(u_et);
et   = double(et)
u_et = double(u_et)
```

```
ea =

   -0.3382


u_ea =

    0.0044


et =

    0.1354


u_et =

    0.0039
```

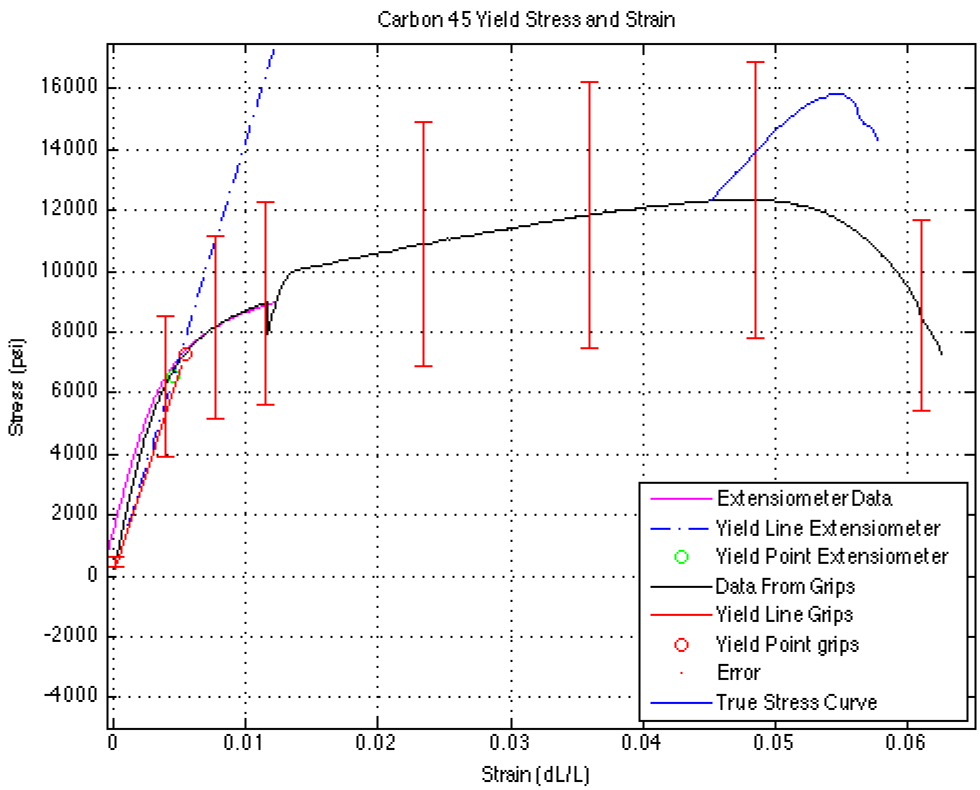
NOW FINDING POISSON'S RATIO AND UNCERTAINTY%%%

```
syms ea1 et1
PR = -et1/ea1; %poission's ratio

u_PR = sqrt((diff(PR,ea1)*u_ea)^2+(diff(PR,et1)*u_ea)^2);

ea1 = ea;
et1 = et;


PR   = subs(PR);
u_PR = subs(u_PR);
PR   = double(PR)
u_PR = double(u_PR)
```

```
PR =

    0.4004


u_PR =

    0.0140
```

GRAPHING ULTIMATE STRESS CURVE

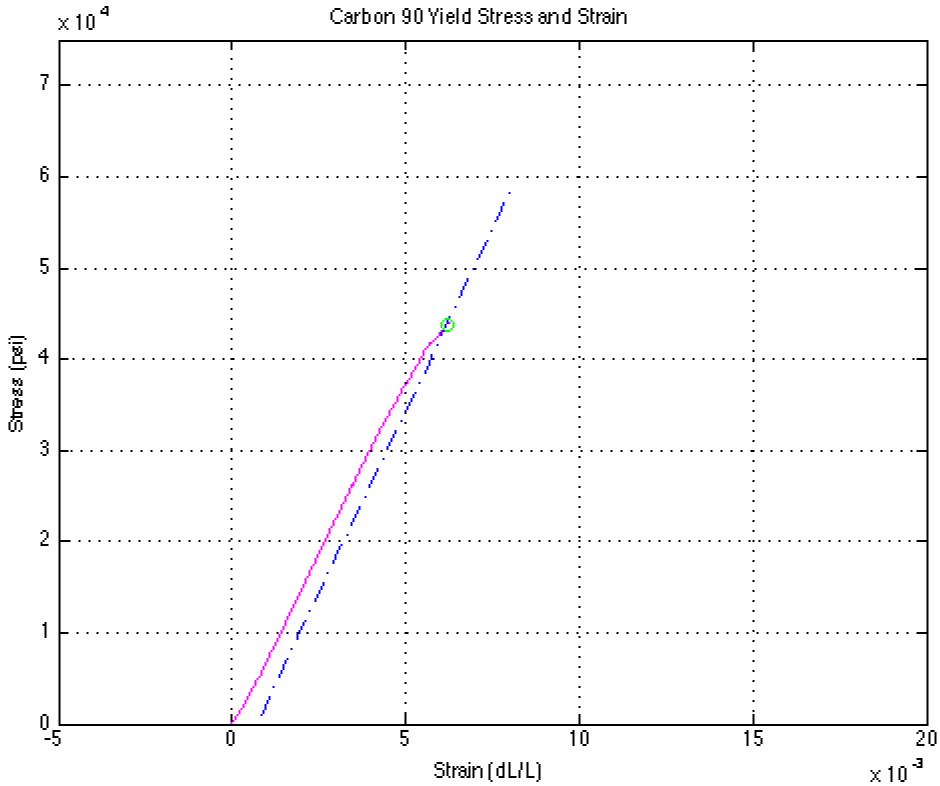
```
Inc = (Ai-Af)./(1070-906);
Ar1 = [Ai:-Inc:Af];
Ar3 = Ar1';
Ar4 = carbon45(906:1070,2);
Ar2 = (Ar4./Ar3);
plot(xx(906:1070),Ar2); hold on

leg1 = legend('Extensiometer Data','Yield Line Extensiometer' ...
,'Yield Point Extensiometer','Data From Grips','Yield Line Grips'...
,'Yield Point grips','Error','True Stress Curve');
set(leg1,'Location','SouthEast')
axis([-.0005 .065 -0.5*10E3 1.75*10E3])
```



Carbon 90 (Data taken from tuesday 1230)

```
clear all
close all
clc

load('carbon90.dat');
y  = carbon90(1:467,2);    %Force
x  = carbon90(1:467,3)+7E-4;    %Strain (extensiometer reading)
xF = carbon90(1:523,1);   %Axial Displacement from Force Grips
yF = carbon90(1:523,2);   %Force (made with same dimensions as FG)

%%%%%Area Uncertainty%%%%%
syms w t

Area = w*t;      %in^2

u_t = .00025;    %uncertainty of thickness (in)
u_w = .00025;    %uncertainty of width (in)

u_Area = sqrt((diff(Area,t)*u_t)^2+(diff(Area,w)*u_w)^2);

t = .066; %in
w = .738; %in

Area   = subs(Area)     %Area
u_Area = subs(u_Area)   %Percent Uncertain

%%%%%%%%%%%%%%%%%%%% GRAPHING %%%%%%%%%%%%%%%%%%%%%%
figure(1)
Sa = y ./ Area;                %Stress
eslope = (Sa(100,1)-Sa(90,1)) ./ (carbon90(100,3)-carbon90(90,3)); %slope of linea

L1 = eslope .* carbon90(1:50);

plot(x,Sa,'-m');hold on             %Stress vs Strain

title('Carbon 90 Yield Stress and Strain'); %Graph formatting
xlabel('Strain (dL/L)');
ylabel('Stress (psi)');
grid on
axis([-.005 .02 0 7.5*10E3])
L2 = L1*.998;    % .2% offset

plot(carbon90(1:50)+7E-4 , L2,'-.b');hold on   % .2% offset
%%%%% Finding .2% offset intersection (yield point) %%%%%
y1  = Sa(300:400);
y2  = transpose(carbon90(300:400) .* .998 .* eslope);
idx = find(abs(y1 - y2) == min(abs(y1 - y2)));
iy = y1(idx)+9500                  %finds y intercept
ix = (iy ./ (eslope .* .998))+7E-4     %finds corresponding x intercept

plot(ix , iy ,'og');hold on     %Plotting the yield point
```

```
Area =

    0.0487


u_Area =

   1.8524e-04


iy =

   4.3833e+04


ix =

    0.0062
```



GRAPHING 2

```
L0  = 6;                  %initial length (in)
SaF = yF ./ Area;           %converting to (psi)
xx  = xF ./ L0;             %Strain from force grips (dimensionless)
```

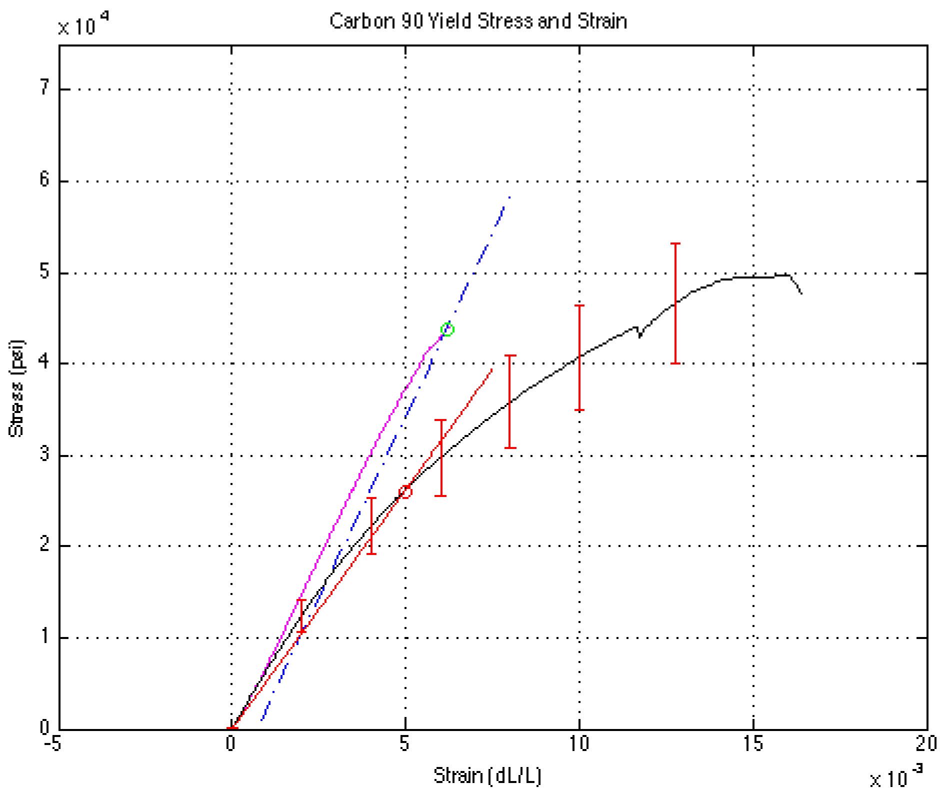
```
plot(xx,SaF,'k');hold on     %plotting strain vs stress

%%%%% slope of linear region with .2 %%%%%
eslopeF = .998 .* (SaF(150,1)-SaF(50,1)) ./ (xx(150,1)-xx(50,1));

L3 = eslopeF .* xx(1:300);

plot(xx(1:300),L3,'-r');hold on

title('Carbon 90 Yield Stress and Strain'); %Graph formatting
xlabel('Strain (dL/L)');
ylabel('Stress (psi)');
grid on

%%%%% Finding .2% offset intersection (yield point) %%%%%
Y1  = SaF(166:400);
Y2  = (xx(166:400) .* eslopeF);
Idx = find(abs(Y1 - Y2) == min(abs(Y1 - Y2)));
Iy = Y1(Idx)                        %finds y intercept
Ix = Iy ./ (eslopeF .* .998)        %finds corresponding x intercept

plot(Ix , Iy ,'or');hold on         %Plotting the yield point

%%%%% Finding Uncertainties For Stress and Strain %%%%%
%%%% STRAIN UNCERTAINTY FORCE GRIPS %%%

xxu = xF ./ L0;

u_xF = .01;        %uncertainty of force
u_L0 = (1/64);     %uncertainty of length (in)

%u_xxu = sqrt((diff(xxu,xF)*u_xF).^2+(diff(xxu,L0).*u_L0).^2)

L0  = 6;                 %initial length (in)
xF = carbon90(1:523,1);

xxu   = subs(xxu);       %Array Uncertainty for Strain with Force Grips(FG)
u_xxu = (1./(500000.*6.5.^2) + xF.^2./(4096.*6.5.^4)).^(1/2);   %Uncertainty for S

%%%% STRESS UNCERTAINTY FORCE GRIPS %%%
syms yF Area

yyu = yF ./ Area;

u_yF  = .01;                %uncertainty of force
cArea = u_Area .* 100;      %uncertainty of Area (in)

u_yyu = sqrt((diff(yyu,yF)*u_yF)^2+(diff(yyu,Area)*cArea)^2);

yF   = carbon90(1:523,2);   %Force
Area = .08            ;   %area

yyu   = subs(yyu);       %Array Uncertainty for Stress with FG
```

```
u_yyu = subs(u_yyu);    %Uncertainty for Stress with FG
```

Decreases the number of data point for a simpler graph %%%

```
u_yyu2 = u_yyu(1:80:523);
xx2    = xx(1:80:523);
SaF   = SaF(1:80:523);
xxu2 = u_xxu(1:80:523);

%%%%%%%%%% PLOTTING ERRORBARS ON GRAPH %%%%%%%%%%
errorbar(xx2,SaF,u_yyu2,'.r');hold on
%herrorbar(xx2,SaF,xxu2,'.r');hold on
```

```
        Iy =

           2.6054e+04


        Ix =

            0.0050
```



ULTIMATE STRESS AND STRAIN

```
UStrain = max(xx2)    %dL/L
UStress = max(SaF)   %psi
%%ASSOCIATED UNCERTAINTY
u_UStress = max(u_xxu)
u_UStrain = max(u_yyu)
```

```
UStrain =

    0.0128


UStress =

   4.6625e+04


u_UStress =

   2.2060e-04


u_UStrain =

   6.9981e+03
```

RUPTURE STRESS AND STRAIN

```
xF  = carbon90(1:523,1);
yf  = carbon90(1:523,2);
xx  = xF ./ L0;
SaF = yf ./ Area;
RStrain = max(xx)
RStress = SaF(523)
%%ASSOCIATED UNCERTAINTY%%
u_RStrain  = u_xxu(523)
u_RStress  = u_yyu(523)
```

```
RStrain =

    0.0164


RStress =

   2.9060e+04
```

```
u_RStrain =

   2.2060e-04


u_RStress =

   6.7288e+03
```

TRUE RUPTURE STRESS AND STRAIN

```
%%First Finding Area final and its Uncertainty:
syms wf tf
Af = wf*tf; %in^2

u_tf = .00025;    %uncertainty of thickness (in)
u_wf = .00025;    %uncertainty of width (in)

u_Af = sqrt((diff(Af,tf)*u_tf)^2+(diff(Af,wf)*u_wf)^2);

wf = .745;  %in
tf = .059;  %in

Af   = subs(Af);     %Area final
u_Af = subs(u_Af);   %Percent Uncertain

%%Now Calculating True Rupture Stress%%
yF = carbon90(523,2);
TRStress = yF ./ Af

%%UNCERTAINTY OF TRSTRESS%%
syms yF Af1
TRStress = yF ./ Af1;

u_yF  = .005;       %uncertainty of Force (lb)
u_Af1 = u_Af;

u_TRStress = sqrt((diff(TRStress,yF)*u_yF)^2+(diff(TRStress,Af1)*u_Af1)^2);

yF   = carbon90(523,2);
Af1  = Af;

TRStress   = subs(TRStress);     %TStress
u_TRStress = subs(u_TRStress)    %Uncertainty of true rupture stress
%%%TRUE RUPTURE STRAIN IS THE SAME AS RUPTURE STRAIN%%%
%THEREFORE I CAN USE THE SAME DATA
RStrain    = max(xx)
u_RStrain  = u_xxu(523)


TRStress =
```

```
   5.2891e+04


u_TRStress =

  224.8157


RStrain =

    0.0164


u_RStrain =

   2.2060e-04
```

PERCENT ELONGATION

```
syms Lf Li
PE = ((Lf-Li)/Li)*100;

u_Lf = (1/64); %(in)
u_Li = (1/64); %(in)

uPE = sqrt((diff(PE,Lf)*u_Lf)^2+(diff(PE,Li)*u_Li)^2);

Lf = 6+(1/8);  %in
Li = 6;          %in

PE   = subs(PE);   %Percent Elongation
uPE  = subs(uPE);  %Uncertainty of Percent Elongation
PE  = double(PE)
uPE = double(uPE)
```

```
PE =

    2.0833


uPE =

    0.3721
```

PERCENT AREA REDUCED

```
syms Ai Afi
PAR  = ((Ai-Afi)/Ai)*100;
```

```
u_Ai  = u_Area;
u_Afi = u_Af;

uPAR = sqrt((diff(PAR,Ai)*u_Ai)^2+(diff(PAR,Afi)*u_Afi)^2);

Ai  = Area;
Afi = Af;

PAR  = subs(PAR);
uPAR = subs(uPAR);
PAR  = double(PAR)
uPAR = double(uPAR)
```

```
PAR =

   45.0563


uPAR =

    0.2659
```

MODULUS OF ELASTICITY ITS ESLOPE

```
%%%%%MODULUS AND UNCERTAINTY OF EXTENSIOMETER%%%%%
syms hy ly hx lx

u_hy = .01;
u_ly = .01;
u_hx = .01;
u_lx = .01;

ModEE  = (hy-ly) ./ (hx-lx).* .998;

uModEE = sqrt((diff(ModEE,hy)*u_hy)^2+(diff(ModEE,ly)*u_ly)^2 ...
+(diff(ModEE,lx)*u_lx)^2+(diff(ModEE,hx)*u_hx)^2);

hy = Sa(100,1);
ly = Sa(50,1);
hx = carbon90(100,3);
lx = carbon90(50,3);

ModEE  = subs(ModEE);     %MODULUS OF ELACTICITY FOR EXTENSIOMETER
uModEE = subs(uModEE);    %UNCERTAINTY OF MODULUS OF ELACTICITY FOR EXT
ModEE  = double(ModEE)
uModEE = double(uModEE)
```

```
ModEE =

   7.8488e+06
```

```
uModEE =

   1.2142e+08
```

MODULUS AND UNCERTAINTY OF FORCE GRIPS

```
syms hy ly hx lx
u_hy = .01;
u_ly = .01;
u_hx = .01;
u_lx = .01;

eslopeF = .998 .* (SaF(150,1)-SaF(50,1)) ./ (xx(150,1)-xx(50,1));

ModEF  = (hy-ly) ./ (hx-lx).* .998;

uModEF = sqrt((diff(ModEF,hy)*u_hy)^2+(diff(ModEF,ly)*u_ly)^2 ...
+(diff(ModEF,lx)*u_lx)^2+(diff(ModEF,hx)*u_hx)^2);

hy = SaF(150,1);
ly = SaF(50,1);
hx = xx(150,1);
lx = xx(50,1);

ModEF  = subs(ModEF);     %MODULUS OF ELACTICITY FOR FORCE GRIPS
uModEF = subs(uModEF);    %UNCERTAINTY OF MODULUS OF ELACTICITY FOR FG
ModEF  = double(ModEF)
uModEF = double(uModEF)
```

```
ModEF =

   3.1951e+06


uModEF =

   1.8055e+07
```

MODULUS OF RESILIENCE FOR EXTENSIOMETER

```
Sa = y ./ Area;
x  = carbon90(1:467,3);
n = 467;
w=0;
```

```
for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSR = w
```

```
        MODULUSR =

           1.5037e+03
```

MODULUS OF Toughness for Force Grips

```
yF = carbon90(1:467,2);
Sa = yF ./ Area;
n = 467;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSTF = w
```

```
        MODULUSTF =

           1.5037e+03
```

MODULUS OF Toughness for Force Grips

```
yF = carbon90(1:523,2);
Sa = yF ./ Area;
n = 523;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSTF = w
```

```
        MODULUSTF =

           2.3947e+03
```

POISSON'S RATIO

```
%%%TRANSVERSE STRAIN AND ITS UNCERTAINTY%%%
```

```
syms it ft
ea = (ft-it)/it;

u_it = .00025; %(in)
u_ft = .00025; %(in)

u_ea = sqrt((diff(ea,it)*u_it)^2+(diff(ea,ft)*u_ft)^2);

ft = .059; %(in)
it = .066;%(in)

ea   = subs(ea);
u_ea = subs(u_ea);
ea   = double(ea)
u_ea = double(u_ea)

%%%AXIAL STRAIN AND ITS UNCERTAINTY%%%
syms il fl
et = (fl-il)/il;

u_il = (1/64); %(in)
u_fl = (1/64); %(in)

u_et = sqrt((diff(et,il)*u_il)^2+(diff(et,fl)*u_fl)^2);

fl = 6+(1/8); %(in)
il = 6;    %(in)

et   = subs(et);
u_et = subs(u_et);
et   = double(et)
u_et = double(u_et)
```

```
ea =

   -0.1061


u_ea =

    0.0051


et =

    0.0208


u_et =

    0.0037
```

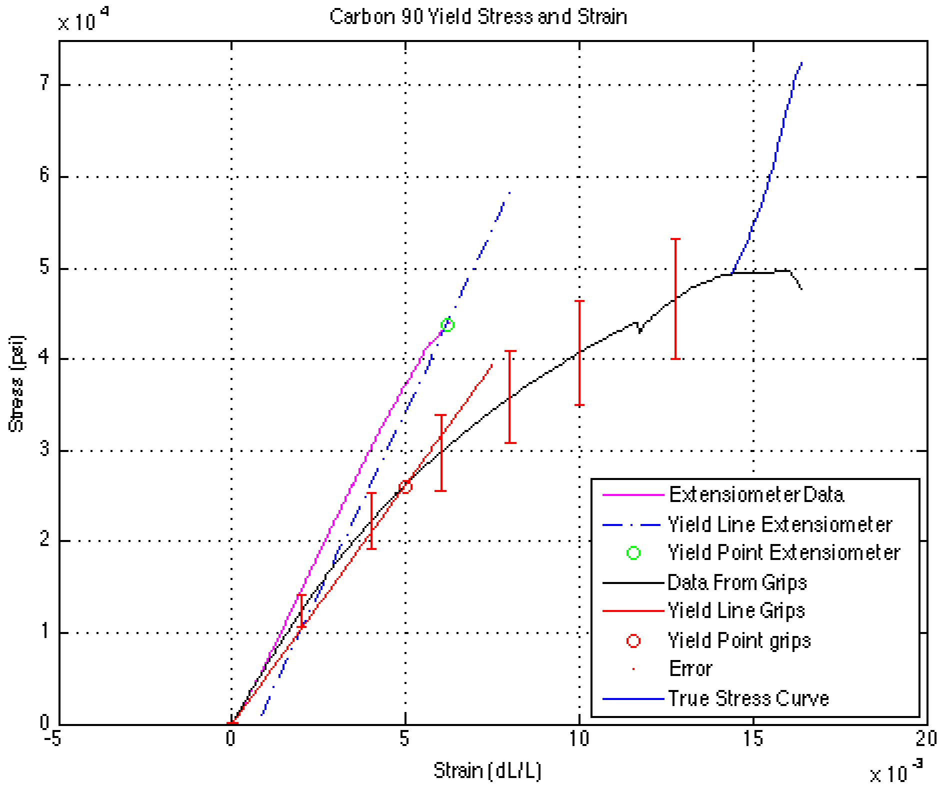
NOW FINDING POISSON'S RATIO AND UNCERTAINTY

```
syms ea1 et1
PR = -et1/ea1; %poission's ratio

u_PR = sqrt((diff(PR,ea1)*u_ea)^2+(diff(PR,et1)*u_ea)^2);

ea1 = ea;
et1 = et;


PR   = subs(PR);
u_PR = subs(u_PR);
PR   = double(PR)
u_PR = double(u_PR)
```

```
PR =

    0.1964


u_PR =

    0.0488
```

GRAPHING ULTIMATE STRESS CURVE

```
Inc = (Ai-Af)./(523-500);
Ar1 = [Ai:-Inc:Af];
Ar3 = Ar1';
Ar4 = carbon90(500:523,2);
Ar2 = (Ar4./Ar3)+19500;
plot(xx(500:523),Ar2); hold on

leg1 = legend('Extensiometer Data','Yield Line Extensiometer' ...
,'Yield Point Extensiometer','Data From Grips','Yield Line Grips'...
,'Yield Point grips','Error','True Stress Curve');
set(leg1,'Location','SouthEast')
```



Steel

```
clear all
close all
clc
load('steel.dat')

y  = steel(1:466,2);   %Force
x  = steel(1:466,3);   %Strain (extensiometer reading)
xF = steel(1:2482,1);   %Axial Displacement from Force Grips
yF = steel(1:2482,2);   %Force (made with same dimensions as FG)
```

Area Uncertainty

```
syms w t

Area = w*t;       %in^2

u_t = .00025;     %uncertainty of thickness (in)
u_w = .00025;     %uncertainty of width (in)

u_Area = sqrt((diff(Area,t)*u_t)^2+(diff(Area,w)*u_w)^2);

t = .083; %in
w = .367; %in
```

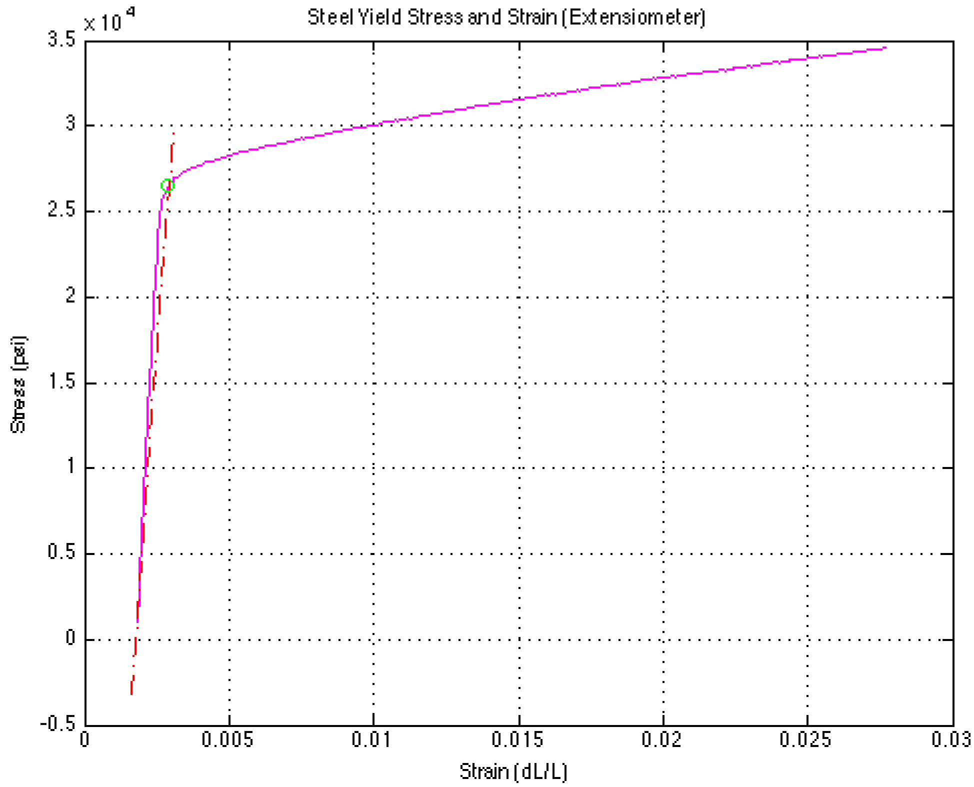
```
Area   = subs(Area)     %Area
u_Area = subs(u_Area)   %Percent Uncertain
```

```
Area =

    0.0305


u_Area =

   9.4067e-05
```

GRAPHING

```
figure()
Sa = y ./ Area;                %Stress

%slope of linear region
eslope = (Sa(40,1)-Sa(1,1)) ./ (steel(40,3)-steel(1,3));
L1 = (eslope .* steel(12:22))-40000;

%plot(steel(12:22),L1);hold on

plot(x,Sa,'-m');hold on             %Stress vs Strain

title('Steel Yield Stress and Strain (Extensiometer)'); %Graph formatting
xlabel('Strain (dL/L)');
ylabel('Stress (psi)');
grid on
L2 = L1*.998;    % .2% offset

plot(steel(12:22) , L2,'-.r');hold on   % .2% offset

%%%%% Finding .2% offset intersection (yield point) %%%%%
y1  = Sa(130:375);
y2  = transpose(steel(130:375) .* .998 .* eslope);
idx = find(abs(y1 - y2) == min(abs(y1 - y2)));
iy = y1(idx)-3E3                    %finds y intercept
ix = (iy ./ (eslope .* .998))+1.7E-3     %finds corresponding x intercept

plot(ix , iy ,'og');hold on     %Plotting the yield point
```

```
iy =

   2.6566e+04


ix =

    0.0029
```



GRAPHING 2

```
L0  = 6.5;                  %initial length (in)
SaF = yF ./ Area;           %converting to (psi)
xx  = xF ./ L0;             %Strain from force grips (dimensionless)

plot(xx,SaF,'k');hold on     %plotting strain vs stress

%%%%% slope of linear region with .2 %%%%%
eslopeF = .998 .* (SaF(40,1)-SaF(1,1)) ./ (xx(40,1)-xx(1,1));

L3 = eslopeF .* xx(10:200);

plot(xx(10:200),L3,'-r');hold on

title('Steel Yield Stress and Strain (Force Grips)'); %Graph formatting
xlabel('Strain (dL/L)');
ylabel('Stress (psi)');
grid on
axis([-.02 .18 0 5*10E3])

%%%%% Finding .2% offset intersection (yield point) %%%%%
Y1  = SaF(166:400);
Y2  = (xx(166:400) .* eslopeF);
```

```
Idx = find(abs(Y1 - Y2) == min(abs(Y1 - Y2)));
Iy = Y1(Idx)                        %finds y intercept
Ix = Iy ./ (eslopeF .* .998)        %finds corresponding x intercept

plot(Ix , Iy ,'or');hold on         %Plotting the yield point

%%%%%%%%%%% Finding Uncertainties For Stress and Strain %%%%%%%%%%
%%%% STRAIN UNCERTAINTY FORCE GRIPS %%%
xxu = xF ./ L0;

u_xF = .01;         %uncertainty of force
u_L0 = (1/64);      %uncertainty of length (in)

%u_xxu = sqrt((diff(xxu,xF)*u_xF).^2+(diff(xxu,L0).*u_L0).^2)

L0  = 6.5;                 %initial length (in)
xF = steel(1:2482,1);

xxu   = subs(xxu);      %Array Uncertainty for Strain with Force Grips(FG)
u_xxu = (1./(500000.*6.5.^2) + xF.^2./(4096.*6.5.^4)).^(1/2);   %Uncertainty for S

%%%% STRESS UNCERTAINTY FORCE GRIPS %%%
syms yF Area

yyu = yF ./ Area;

u_yF  = .01;                %uncertainty of force
cArea = u_Area .* 100;      %uncertainty of Area (in)

u_yyu = sqrt((diff(yyu,yF)*u_yF)^2+(diff(yyu,Area)*cArea)^2);

yF   = steel(1:2482,2);     %Force
Area = .0853          ;     %area

yyu   = subs(yyu);      %Array Uncertainty for Stress with FG
u_yyu = subs(u_yyu);    %Uncertainty for Stress with FG
```

Decreases the number of data point for a simpler graph %%%

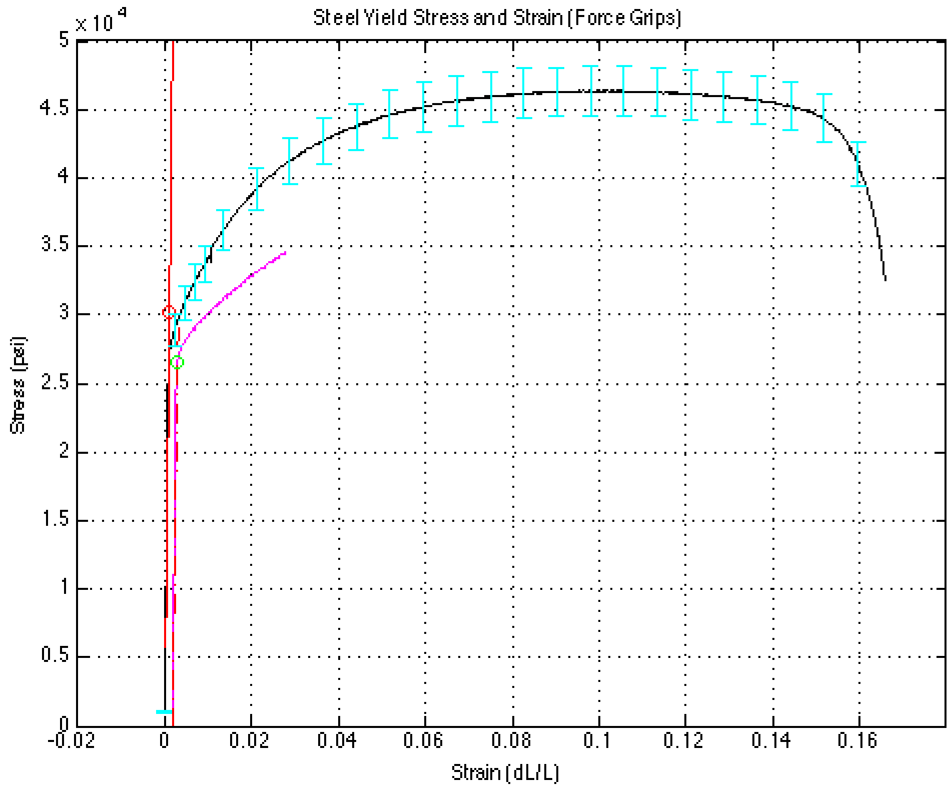
```
u_yyu2 = u_yyu(1:100:2482);
xx2    = xx(1:100:2482);
SaF   = SaF(1:100:2482);
xxu2 = u_xxu(1:100:2482);

%%%%%%%%%%% PLOTTING ERRORBARS ON GRAPH %%%%%%%%%%%
errorbar(xx2,SaF,u_yyu2,'.c');hold on
%herrorbar(xx2,SaF,xxu2,'.m');hold on
```

```
        Iy =
```

3.0250e+04

Ix =

0.0011



ULTIMATE STRESS AND STRAIN AND PLOTTING THIS POINT

```
UStrain = max(xx2)    %dL/L
UStress = max(SaF)   %psi
%%ASSOCIATED UNCERTAINTY
u_UStress = max(u_xxu)
u_UStrain = max(u_yyu)
```

UStrain =

0.1596

UStress =

```
   4.6346e+04


u_UStress =

   4.5414e-04


u_UStrain =

   1.8263e+03
```

RUPTURE STRESS AND STRAIN

```
xF  = steel(1:2482,1);
yf  = steel(1:2482,2);
xx  = xF ./ L0;
SaF = yf ./ Area;
RStrain = max(xx)
RStress = SaF(2482)
%%ASSOCIATED UNCERTAINTY%%
u_RStrain  = u_xxu(2482)
u_RStress  = u_yyu(2482)
```

```
RStrain =

    0.1658


RStress =

   1.1629e+04


u_RStrain =

   4.5414e-04


u_RStress =

   1.2824e+03
```

TRUE RUPTURE STRESS AND STRAIN

```
%%First Finding Area final and its Uncertainty:
syms wf tf
Af = wf*tf; %in^2
```

```
u_tf = .00025;    %uncertainty of thickness (in)
u_wf = .00025;    %uncertainty of width (in)

u_Af = sqrt((diff(Af,tf)*u_tf)^2+(diff(Af,wf)*u_wf)^2);

wf = .219;  %in
tf = .054;  %in

Af   = subs(Af);     %Area final
u_Af = subs(u_Af);   %Percent Uncertain

%%Now Calculating True Rupture Stress%%
yF = steel(2482,2);
TRStress = yF ./ Af

%%UNCERTAINTY OF TRSTRESS%%
syms yF Af1
TRStress = yF ./ Af1;

u_yF  = .005;      %uncertainty of Force (lb)
u_Af1 = u_Af;

u_TRStress = sqrt((diff(TRStress,yF)*u_yF)^2+(diff(TRStress,Af1)*u_Af1)^2);

yF   = steel(2482,2);
Af1  = Af;

TRStress   = subs(TRStress);     %TStress
u_TRStress = subs(u_TRStress)    %Uncertainty of true rupture stress
```

```
TRStress =

   8.3876e+04


u_TRStress =

  399.9462
```

PERCENT ELONGATION

```
syms Lf Li
PE = ((Lf-Li)/Li)*100;

u_Lf = (1/64); %(in)
u_Li = (1/64); %(in)

uPE = sqrt((diff(PE,Lf)*u_Lf)^2+(diff(PE,Li)*u_Li)^2);

Lf = 7.4375;
Li = 6.5;
```

```
PE   = subs(PE);   %Percent Elongation
uPE  = subs(uPE);  %Uncertainty of Percent Elongation
PE = double(PE)
uPE = double(uPE)
```

```
        PE =

           14.4231


        uPE =

            0.3653
```

PERCENT AREA REDUCED

```
syms Ai Afi
PAR  = ((Ai-Afi)/Ai)*100;

u_Ai  = u_Area;
u_Afi = u_Af;

uPAR = sqrt((diff(PAR,Ai)*u_Ai)^2+(diff(PAR,Afi)*u_Afi)^2);

Ai  = Area;
Afi = Af;

PAR  = subs(PAR);
uPAR = subs(uPAR);
PAR  = double(PAR)
uPAR = double(uPAR)
```

```
        PAR =

           86.1360


        uPAR =

            0.0679
```

MODULUS OF ELASTICITY IS ESLOPE

```
%%%%%MODULUS AND UNCERTAINTY OF EXTENSIOMETER%%%%%
syms hy ly hx lx

u_hy = .01;
```

```
u_ly = .01;
u_hx = .01;
u_lx = .01;

ModEE  = (hy-ly) ./ (hx-lx).* .998;

uModEE = sqrt((diff(ModEE,hy)*u_hy)^2+(diff(ModEE,ly)*u_ly)^2 ...
+(diff(ModEE,lx)*u_lx)^2+(diff(ModEE,hx)*u_hx)^2);

hy = Sa(100,1);
ly = Sa(50,1);
hx = steel(100,3);
lx = steel(50,3);

ModEE  = subs(ModEE);     %MODULUS OF ELACTICITY FOR EXTENSIOMETER
uModEE = subs(uModEE);    %UNCERTAINTY OF MODULUS OF ELACTICITY FOR EXT
ModEE  = double(ModEE)
uModEE = double(uModEE)
```

```
ModEE =

   5.1000e+05


uModEE =

   2.3712e+06
```

MODULUS AND UNCERTAINTY OF FORCE GRIPS

```
syms hy ly hx lx
u_hy = .01;
u_ly = .01;
u_hx = .01;
u_lx = .01;

eslopeF = .998 .* (SaF(150,1)-SaF(50,1)) ./ (xx(150,1)-xx(50,1));

ModEF  = (hy-ly) ./ (hx-lx).* .998;

uModEF = sqrt((diff(ModEF,hy)*u_hy)^2+(diff(ModEF,ly)*u_ly)^2 ...
+(diff(ModEF,lx)*u_lx)^2+(diff(ModEF,hx)*u_hx)^2);

hy = SaF(40,1);
ly = SaF(1,1);
hx = xx(40,1);
lx = xx(1,1);

ModEF  = subs(ModEF);     %MODULUS OF ELACTICITY FOR FORCE GRIPS
```

```
uModEF = subs(uModEF);     %UNCERTAINTY OF MODULUS OF ELACTICITY FOR FG
ModEF  = double(ModEF)
uModEF = double(uModEF)
```

ModEF =

1.0132e+07

uModEF =

1.5936e+08

MODULUS OF RESILIENCE FOR EXTENSIOMETER

```
Sa = y ./ Area;
x  = steel(1:466,3);
n = 466;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSR = w
```

MODULUSR =

804.3389

MODULUS OF RESILIENCE FOR FORCE GRIPS

```
yF = steel(1:466,2);
Sa = yF ./ Area;
n = 466;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSTF = w
```

MODULUSTF =

804.3389

MODULUS OF Toughness for Force Grips

```
yF = steel(1:2482,2);
Sa = yF ./ Area;
n = 2482;
w=0;

for i=1: n-2
w = w+ ((xF(i+1)-xF(i)) .* Sa(i))+(.5*((Sa(i+2)-Sa(i+1)) .* xF(i+1)));
end
MODULUSTF = w
```

MODULUSTF =

1.4573e+04

POISSON'S RATIO

```
%%%TRANSVERSE STRAIN AND ITS UNCERTAINTY%%%
syms it ft
ea = (ft-it)/it;

u_it = .00025; %(in)
u_ft = .00025; %(in)

u_ea = sqrt((diff(ea,it)*u_it)^2+(diff(ea,ft)*u_ft)^2);

ft = .054; %(in)
it = .083;%(in)

ea   = subs(ea);
u_ea = subs(u_ea);
ea   = double(ea)
u_ea = double(u_ea)
%%%AXIAL STRAIN AND ITS UNCERTAINTY%%%
syms il fl
et = (fl-il)/il;

u_il = (1/64); %(in)
u_fl = (1/64); %(in)

u_et = sqrt((diff(et,il)*u_il)^2+(diff(et,fl)*u_fl)^2);

fl = 7.4375; %(in)
il = 6.5;    %(in)

et   = subs(et);
u_et = subs(u_et);
et   = double(et)
u_et = double(u_et)
```

```
ea =

   -0.3494


u_ea =

    0.0036


et =

    0.1442


u_et =

    0.0037
```

NOW FINDING POISSON'S RATIO AND UNCERTAINTY

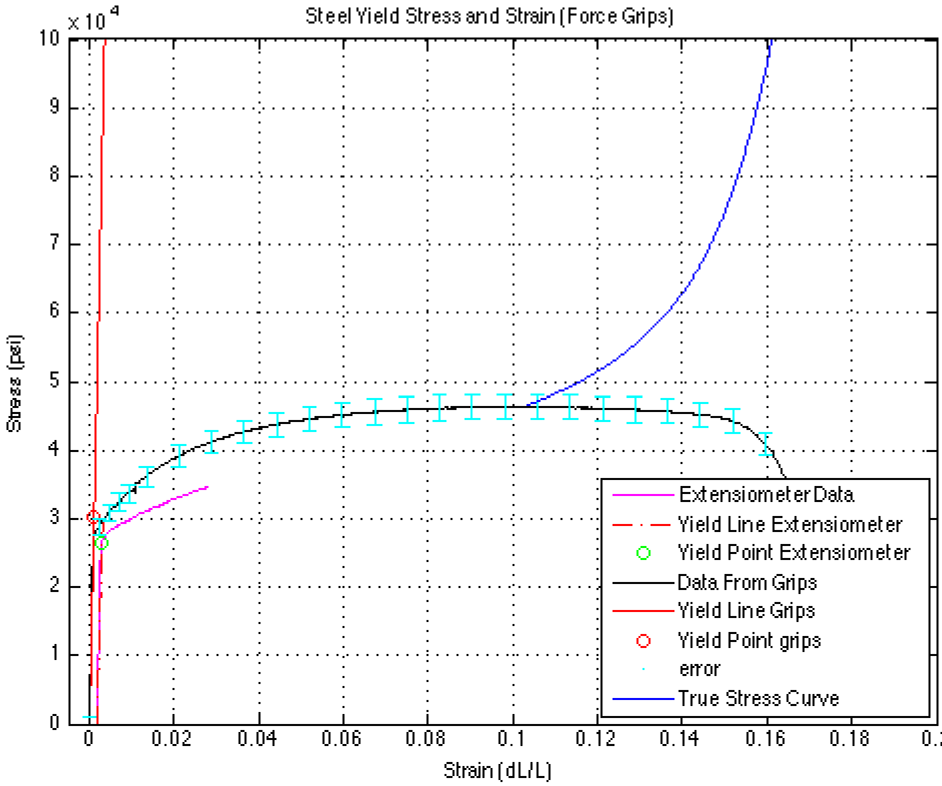
```
syms ea1 et1
PR = -et1/ea1; %poission's ratio

u_PR = sqrt((diff(PR,ea1)*u_ea)^2+(diff(PR,et1)*u_ea)^2);

ea1 = ea;
et1 = et;


PR   = subs(PR);
u_PR = subs(u_PR);
PR   = double(PR)
u_PR = double(u_PR)
```

```
PR =

    0.4128


u_PR =

    0.0111
```

GRAPHING ULTIMATE STRESS CURVE

```
Inc = (Ai-Af)./(2482-1669);
```

```
Ar1 = [Ai:-Inc:Af];
Ar3 = Ar1';
Ar4 = steel(1669:2482,2);
Ar2 = (Ar4./Ar3)+30000;
plot(xx(1669:2482),Ar2); hold on

leg1 = legend('Extensiometer Data','Yield Line Extensiometer' ...
,'Yield Point Extensiometer','Data From Grips','Yield Line Grips'...
,'Yield Point grips','error','True Stress Curve');
set(leg1,'Location','SouthEast')
axis([-.005 .2 0 10*10E3])
```



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