runSvanbergSLP.m script to run SLP for Svanberg's 5-segment beam.

Svanberg, Krister, "The Method of Moving Asymptotes--A New Method for Structural Optimization," Intl. J. Num. Meth. Vol. 24, 1987, pp. 359-373.

Contents

Initialize Variables & options

```
clear; clc; close all
Nsegments=5;
Xinitial=5;
X0=repmat(Xinitial,Nsegments,1); vlb=zeros(Nsegments,1);
options.Display='iter';
options.MaxIter=30;
options.TolX=0.1;
options.TolFun=0.001;
options.TolCon=0.0001;
%options.MoveLimit=1; % relative to X0; absolute, if options.TypicalX=1
%options.MoveReduction=0.8;
%options.TrustRegion='off';
```

SLP

```
[x,f,exitflag,output]=slp_trust(@fSvanbergBeam,X0,options,vlb,[],@gSvanbergBeam);
disp(' ')
disp('Final Design Variables, X')
disp(x)
```

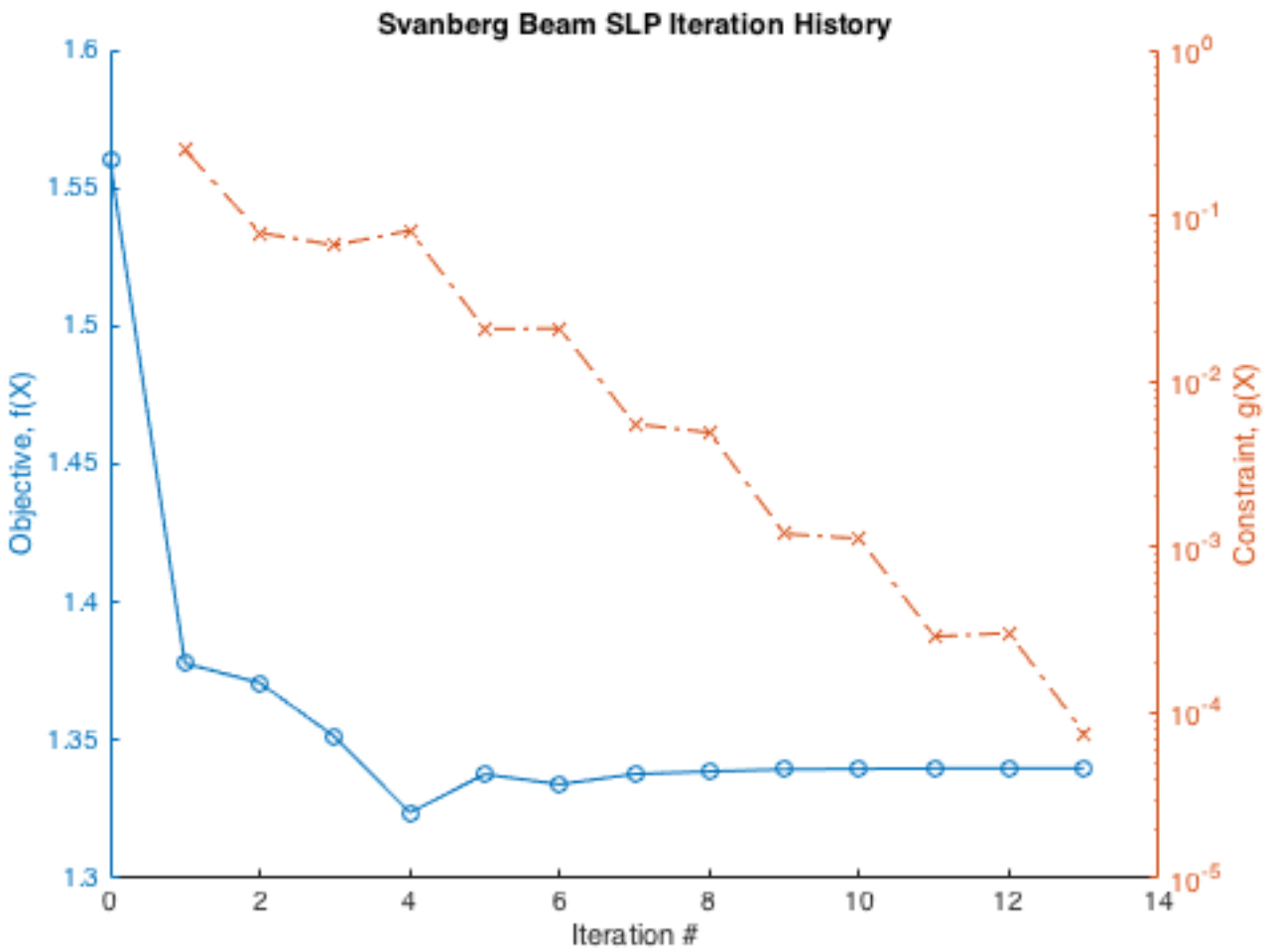
```
         Sequential Linear Programming Iteration History
 Iteration      Objective MaxConstraint    Index   Step-size   Merit      MoveLimit  TrustRatio
         0           1.56             0        1           0        1.56
         1         1.3779        0.2486        1           1        1.56        0.2           0
         2         1.3708       0.07887        1         0.5       1.429        0.1      0.6946
         3         1.3513        0.0663        1         0.5         1.4        0.1      0.3718
         4         1.3238       0.08129        1         0.5         1.4        0.1           0
         5         1.3377       0.02069        1        0.25       1.357       0.05      0.6884
         6         1.3341       0.02085        1        0.25       1.357       0.05           0
         7         1.3378      0.005535        1       0.125       1.344      0.025      0.6832
         8         1.3387       0.00491        1       0.125       1.344      0.025     -0.04444
         9         1.3395      0.001203        1      0.0625       1.341     0.0125      0.7145
        10         1.3397      0.001125        1      0.0625       1.341     0.0125     -0.06297
        11         1.3399     0.0002886        1     0.03125        1.34    0.00625      0.6985
```

```
       12          1.3399      0.0003026       1      0.03125          1.34     0.00625      -0.3026
Rejected
       13            1.34      7.551e-05       1      0.01562          1.34    0.003125       0.6255
Bound
               ----------  ------------          ----------
    Criteria        0.001         0.0001                 0.1
SLP converged. Final objective function value = 1.34
               Lagrangian gradient   2-norm = 0.0023432
               Lagrangian gradient inf-norm = 0.001821

Final Design Variables, X
    6.0009
    5.3084
    4.5030
    3.5206
    2.1406
```

Plot iteration history

```
iter=(0:output.iterations);
[AX,H1,H2]=plotyy(iter,output.f,iter,abs(max(output.g,[],1)),'plot','semilogy');
set(get(AX(1),'Ylabel'),'String','Objective, f(X)');
set(get(AX(2),'Ylabel'),'String','Constraint, g(X)');
set(H1,'LineStyle','-','LineWidth',1,'Marker','o');
set(H2,'LineStyle','-.','LineWidth',1,'Marker','x');
xlabel('Iteration #');
title('Svanberg Beam SLP Iteration History');
```



SQP

```
[x,output]=sqp(@fSvanbergBeam,X0,options,vlb,[],@gSvanbergBeam) %#ok<*NOPTS>
```

```
                                    Termination Criteria
                                  0.0001         0.001         0.1
                                 ---------------------------------
f-CNT          FUNC      STEP NAC     max{g}  j        KTO     max(S)
    1          1.56         0   6          0  1    0.00841     0.061
    2        1.5516         1   6   0.000166  1      0.041     0.304
    3        1.5106         1   6    0.00414  1      0.165      1.31
    4        1.3483         1   6        0.1  1       0.13     0.207
    5        1.3934         1   6    0.00827  1     0.0331     0.457
    6         1.364         1   6     0.0116  1     0.0507      0.99
    7        1.3186         1   6     0.0873  1     0.0538     0.355
    8        1.3377         1   6      0.025  1     0.0194    0.0605
    9        1.3463         1   6   0.000845  1    0.00222     0.096
   10        1.3444         1   6   0.000941  1    0.00496     0.169
   11        1.3398         1   6    0.00507  1     0.0024    0.0999
   12        1.3401         1   6    0.00126  1   0.000801    0.0874
   13        1.3398         1   6   0.000882  1   0.000753   0.00428
   14        1.3402         1   6   3.48e-06  1   0.000148    0.0203
Optimization Terminated Successfully from sqp


x =

    6.0719
    5.2585
    4.4547
    3.5437
    2.1485


output =

          fval: 1.3402
     funcCount: 14
     gradCount: 14
    iterations: 13
       options: [1x18 double]
```

Linear Objective function, Nonlinear constraints, 5-DV

```
type fSvanbergBeam
```

```
function [f,g] = fSvanbergBeam( x )
% Function evaluation of Svanberg's 5-segment beam
%
%--Input
```

```
%
% x....... Design variable vector = beam cros-sectional dimensions
%
%--Output
% f....... Objective function value f(x)=weight
% g....... Constraint function value g(x)=tip deflection constraint<=0

C1 = 0.0624;
C2 = 1;
f = C1*sum(x);
g = sum( [61 37 19 7 1]'./x(:).^3) - C2;
```

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