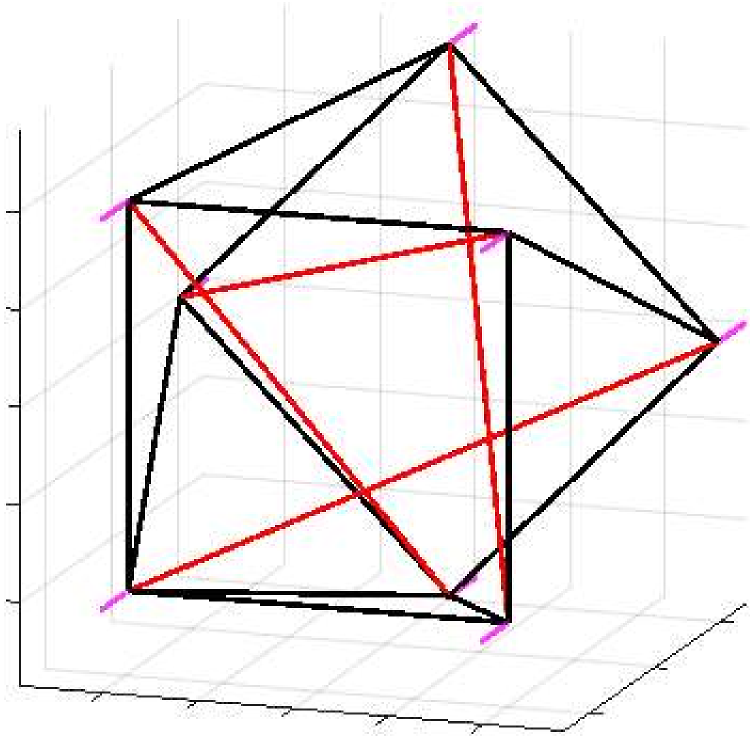
```
% Static force analysis of 2D TBar (Fig 3.3 of Skelton & de Oliviera 2009)
% By Thomas Bewley, UC San Diego (+ faculty fellow at JPL)
clear; clf; figure(1);

theta = 45*pi/180;
r = [cos(theta),0,-sin(theta);0,1,0;sin(theta),0,cos(theta)];
% Free [Q=Q_(dim x q)] and fixed [Q=Q_(dim x q)] node locations
Q(:,1)=[-1,0,-1];
Q(:,2)=[-1,0,1];
Q(:,3)=[1,0,1];
Q(:,4)=[1,0,-1];
Q(:,5)=[-1,2,-1]*r;
Q(:,6)=[-1,2,1]*r;
Q(:,7)=[1,2,1]*r;
Q(:,8)=[1,2,-1]*r;
P=[];
%Q=Q';
[dim,q]=size(Q); p=size(P,2); n=q+p;

C(:,1)=conVect(1,7,8);
C(:,2)=conVect(2,8,8);
C(:,3)=conVect(3,5,8);
C(:,4)=conVect(4,6,8); b = 4;
%C(:,5)=conVect(1,3,8);
%C(:,6)=conVect(2,4,8);
%C(:,5)=conVect(1,6,8);
%C(:,5)=conVect(2,5,8);
%C(:,7)=conVect(2,7,8);
%C(:,6)=conVect(3,6,8);
%C(:,9)=conVect(3,8,8);
%C(:,7)=conVect(4,7,8);
C(:,5)=conVect(1,8,8);
%C(:,12)=conVect(4,5,8);
%C(:,15)=conVect(6,8,8);
%C(:,16)=conVect(5,7,8);
C(:,6)=conVect(1,2,8);
C(:,7)=conVect(2,3,8);
C(:,8)=conVect(3,4,8);
C(:,9)=conVect(4,1,8);
C(:,10)=conVect(1,5,8);
C(:,11)=conVect(2,6,8);
C(:,12)=conVect(3,7,8);
C(:,13)=conVect(4,8,8);
C(:,14)=conVect(5,6,8);
C(:,15)=conVect(6,7,8);
C(:,16)=conVect(7,8,8);
C(:,17)=conVect(8,5,8); s = 13;
%{
% Connectivity matrix
C(  1,1)=1; C(  1,2)=-1;       % bars
C(  2,2)=1; C(  2,3)=-1;
C(  3,2)=1; C(  3,4)=-1;
C(  4,2)=1; C(  4,5)=-1;
C(  5,2)=1; C(  5,6)=-1; b=5;
C(b+1,1)=1; C(b+1,4)=-1;       % strings
```

```
C(b+2,1)=1; C(b+2,5)=-1;
C(b+3,1)=1; C(b+3,6)=-1;
C(b+4,3)=1; C(b+4,4)=-1;
C(b+5,3)=1; C(b+5,5)=-1;
C(b+6,3)=1; C(b+6,6)=-1;
C(b+7,4)=1; C(b+7,5)=-1;
C(b+8,5)=1; C(b+8,6)=-1;
C(b+9,6)=1; C(b+9,4)=-1; s=9; m=b+s;
%}
C = C';
% Applied external force U=U_(dim x q)
U(1:dim,1:q)=0;
%U(1,1)=1; U(1,3)=-1;
U(:,1) = [0; 10; 0];
U(:,2) = [0; 10; 0];
U(:,3) = [0; 10; 0];
U(:,4) = [0; 10; 0];
U(:,5) = [0; -10; 0];
U(:,6) = [0; -10; 0];
U(:,7) = [0; -10; 0];
U(:,8) = [0; -10; 0];

% Solve for the forces at equilibrium, and plot
[c_bars,t_strings,V]=tensegrity_statics(b,s,q,p,dim,Q,P,C,U);
tensegrity_plot(Q,P,C,b,s,U,V,true,1,0.08); grid on;

function C_vect = conVect(start,finish,total_nodes)
C_vect = zeros(1,total_nodes);
C_vect(1,start) = -1;
C_vect(1,finish) = 1;
return
end
% end script TBar3
```

```
mhat =

    24


nhat =

    17


r =

    17

Warning: Ase is potentially inconsistent, implying the presence of soft modes,
or instability!  More strings or fixed points should fix the problem.

Bar compressions and string tensions with loads as specified,
least squares solution (i.e., NO pretensioning):
u in column space of Ase, so at least one solution exists, with residual 4.2781e-14.
```

```
c_bars =

    8.2266    8.2266    8.2266    8.2266

No bars under tension.  Good.

t_strings =

  Columns 1 through 7

   -0.0000    5.0000    5.0000    5.0000    5.0000   -5.6853   -5.6853

  Columns 8 through 13

   -5.6853   -5.6853    5.0000    5.0000    5.0000    5.0000

Some strings not under tension. Needs different tensioning or external loads.

Ase is not underdetermined (thus, it is not tensionable). The above solution is unique.
```



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