Priedai

A priedas. Rėmo bendrosios analizės programinis kodas

1.3.4 poskyrio, skaitinio eksperimento, rėminės konstrukcijos bendrosios analizės uždavinio (1.22)–(1.24) sprendimo programinis kodas MATLAB sistemai

```
clc
clear all

%%Bendroji remo analize veikiant dviem jegoms, pagal (1.22)-(1.24)
mat. mod.
L=[4 3.5 3.5 4 3.5 3.5 4]; %elementu ilgiai, m

%MEDZIAGOS PARAMETRAI
E=205e6; %PLIENO tamprumo modulis
sigy=253.2e3; %PLIENO takumo riba
As=149e-4; %skerspjuvio plotas, m2
```

```
I=25.17e-5; % Inercijos momentas, m4
Wpl=1869e-6; %atsparumo momentas, m3

EI=E*I
EA=E*As;
M0=sigy*Wpl;
N0=sigy*As;
xsi=1;
ck=M0/(xsi*N0); %ribiniu irazu santykis kolonoms, cia xsi -
klupumo koef.
cs=M0/N0; %ribiniu irazu santykis sijoms

%pusiausvyros lygciu koeficientu matrica
A=zeros(17,21);
A(1,2)=1;
A(2,4)=1;
A(3,5)=1; A(3,7)=1;
A(4,8)=1; A(4,13)=1;
A(5,10)=1;
A(6,14)=1; A(6,16)=1;
A(7,17)=1; A(7,19)=1;
A(8,1)=-1/L(1); A(8,2)=-1/L(1); A(8,6)=-1;
A(9,3)=-1; A(9,4)=1/L(2); A(9,5)=1/L(2);
A(10,6)=1; A(10,9)=-1;
A(11,4)=-1/L(2); A(11,5)=-1/L(2); A(11,7)=1/L(3); A(11,8)=1/L(3);
A(12,9)=1; A(12,15)=-1; A(12,10)=-1/L(4); A(12,11)=-1/L(4);
A(13,7)=-1/L(3); A(13,8)=-1/L(3); A(13,13)=1/L(5);
A(13,14)=1/L(5); A(13,12)=-1;
A(14,15)=1; A(14,18)=-1;
A(15,13)=-1/L(5); A(15,14)=-1/L(5); A(15,16)=1/L(6);
A(15,17)=1/L(6);
A(16,18)=1; A(16,19)=-1/L(7); A(16,20)=-1/L(7);
A(17,16)=-1/L(6); A(17,17)=-1/L(6); A(17,21)=-1;

Aeq= -A;

%Uzrasomos visos apkrovu veikimo srities virsunes-vektoriai
F01=341;
F02=440;
F1=[0 0 0 0 0 0 0 0 0 0 F01 0 0 0 0 0 0]';
F2=[0 0 0 0 0 0 0 0 0 0 0 0 0 0 F02 0 0]';
F3=[0 0 0 0 0 0 0 0 0 0 F01 0 0 0 F02 0 0]';


% Formuojama pasiduodamumo matrica D
d=@(LL,EI,EA) [LL/(3*EI) -LL/(6*EI) 0;...
    -LL/(6*EI) LL/(3*EI) 0;...
    0 0 LL/EA];

D=zeros(21,21); %( n x n )
```

```
D=blkdiag(d(L(1),EI,EA), d(L(2),EI,EA), d(L(3),EI,EA),
d(L(4),EI,EA), d(L(5),EI,EA), d(L(6),EI,EA), d(L(7),EI,EA));

% Skaiciuojame irazu influentine matrica:
alfa = inv(D)*A'*inv(A*inv(D)*A');
%poslinkiu influentine
beta=(A*(D^(-1))*A')^(-1);


%skaiciuojamos tamprios irazos
Se_F1=alfa*F1;
Se_F2=alfa*F2;
Se_F3=alfa*F3;

%skaiciuojami tamprus poslinkiai
ue1=beta*F1;
ue2=beta*F2;
ue3=beta*F3;


% Ivedame apribojimu, isreikstu nelygybemis, koeficientu prie
nezinomuju
% matrica:
%Fi matricos sudarymas, realus skerspjuvis
Fi=zeros(84,21); % 14pj. x 6 takumo sal = 84, 7elementai x 3
irazos = 21
% 1 pjuvis
Fi(1:3,1:3)=[1 0 0;...
    1/1.18 0 ck;...
    1/1.18 0 -ck];
Fi(43:45,1:3)=[-1 0 0;...
    -1/1.18 0 ck;...
    -1/1.18 0 -ck];
% 2 pjuvis
Fi(4:6,1:3)=[0 1 0;...
    0 1/1.18 ck;...
    0 1/1.18 -ck];
Fi(46:48,1:3)=[0 -1 0;...
    0 -1/1.18 ck;...
    0 -1/1.18 -ck];
% 3 pjuvis
Fi(7:9,4:6)=[1 0 0;...
    1/1.18 0 cs;...
    1/1.18 0 -cs];
Fi(49:51,4:6)=[-1 0 0;...
    -1/1.18 0 cs;...
    -1/1.18 0 -cs];
% 4 pjuvis
Fi(10:12,4:6)=[0 1 0;...
    0 1/1.18 cs;...
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```
     0 1/1.18 -cs];
Fi(52:54,4:6)=[0 -1 0;...
     0 -1/1.18 cs;...
     0 -1/1.18 -cs];
% 5 pjuvis
Fi(13:15,7:9)=[1 0 0;...
     1/1.18 0 cs;...
     1/1.18 0 -cs];
Fi(55:57,7:9)=[-1 0 0;...
     -1/1.18 0 cs;...
     -1/1.18 0 -cs];
% 6 pjuvis
Fi(16:18,7:9)=[0 1 0;...
     0 1/1.18 cs;...
     0 1/1.18 -cs];
Fi(58:60,7:9)=[0 -1 0;...
     0 -1/1.18 cs;...
     0 -1/1.18 -cs];
% 7 pjuvis
Fi(19:21,10:12)=[1 0 0;...
     1/1.18 0 ck;...
     1/1.18 0 -ck];
Fi(61:63,10:12)=[-1 0 0;...
     -1/1.18 0 ck;...
     -1/1.18 0 -ck];
% 8 pjuvis
Fi(22:24,10:12)=[0 1 0;...
     0 1/1.18 ck;...
     0 1/1.18 -ck];
Fi(64:66,10:12)=[0 -1 0;...
     0 -1/1.18 ck;...
     0 -1/1.18 -ck];
% 9 pjuvis
Fi(25:27,13:15)=[1 0 0;...
     1/1.18 0 cs;...
     1/1.18 0 -cs];
Fi(67:69,13:15)=[-1 0 0;...
     -1/1.18 0 cs;...
     -1/1.18 0 -cs];
% 10 pjuvis
Fi(28:30,13:15)=[0 1 0;...
     0 1/1.18 cs;...
     0 1/1.18 -cs];
Fi(70:72,13:15)=[0 -1 0;...
     0 -1/1.18 cs;...
     0 -1/1.18 -cs];
% 11 pjuvis
Fi(31:33,16:18)=[1 0 0;...
     1/1.18 0 cs;...
     1/1.18 0 -cs];
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```
Fi(73:75,16:18)=[-1 0 0;...
    -1/1.18 0 cs;...
    -1/1.18 0 -cs];
% 12 pjuvis
Fi(34:36,16:18)=[0 1 0;...
    0 1/1.18 cs;...
    0 1/1.18 -cs];
Fi(76:78,16:18)=[0 -1 0;...
    0 -1/1.18 cs;...
    0 -1/1.18 -cs];
% 13 pjuvis
Fi(37:39,19:21)=[1 0 0;...
    1/1.18 0 ck;...
    1/1.18 0 -ck];
Fi(79:81,19:21)=[-1 0 0;...
    -1/1.18 0 ck;...
    -1/1.18 0 -ck];
% 14 pjuvis
Fi(40:42,19:21)=[0 1 0;...
    0 1/1.18 ck;...
    0 1/1.18 -ck];
Fi(82:84,19:21)=[0 -1 0;...
    0 -1/1.18 ck;...
    0 -1/1.18 -ck];

% Anq matricos visoms hodografo virsunems
Anq1=[Fi(1:42,1:21); Fi(43:84,1:21)];
Anq2=[Fi(1:42,1:21); Fi(43:84,1:21)];
Anq3=[Fi(1:42,1:21); Fi(43:84,1:21)];

Anq=[Anq1; Anq2; Anq3];

Sr_previous=zeros(21,1);

global D Sr_previous;


bnq = [M0*ones(42,1)-Fi(1:42,1:21)*Se_F1-Fi(1:42,1:21)*Sr_previ-
ous; M0*ones(42,1)-Fi(43:84,1:21)*Se_F1-Fi(43:84,1:21)*Sr_previ-
ous;
    M0*ones(42,1)-Fi(1:42,1:21)*Se_F2-Fi(1:42,1:21)*Sr_previous;
M0*ones(42,1)-Fi(43:84,1:21)*Se_F2-Fi(43:84,1:21)*Sr_previous;
    M0*ones(42,1)-Fi(1:42,1:21)*Se_F3-Fi(1:42,1:21)*Sr_previous;
M0*ones(42,1)-Fi(43:84,1:21)*Se_F3-Fi(43:84,1:21)*Sr_previous];

x0=zeros(21,1);
lb=[];
ub=[];
beq=zeros(17,1);
```

```
nonlcon=[]; %nera netiesiniu lygybiu ir neligybiu apribojimu
options=optimset('Algorithm','sqp','TolCon',1e-12,'TolFun',1e-
12,'TolX',1e-12,'MaxFunEvals',1e6,'MaxIter',1e6,'PlotFcns',{@op-
timplotfval,@optimplotfunccount});
%'PlotFcns',{@optimplotfval,@optimplotfunccount,@optimplotx,@op-
timplotconstrviolation,@optimplotfirstorderopt,@optimplotstepsize}
[x,fval,exitflag,output,lambda]=fmincon(@my-
fun,x0,Anq,bnq,Aeq,beq,lb,ub,nonlcon,options);

%tikslo funkcijos failas "myfun" pateikiama A priedo gale

%Rezultatai
Sr = x(1:21);

% Msum = Mr_previous + Me_max + Me_min + Mr %+ Me_FC;
Sr_sum_nauji=Sr_previous+Sr;

% takumo_sal_tikrinimas=[Mr_previous+Me_FC+Me_max+Mr-M0; -Mr_pre-
vious-Me_FC-Me_min-Mr-M0];
tak_sal_tik1=[Fi(1:84,1:21)*Sr_previ-
ous+Fi(1:84,1:21)*Sr+Fi(1:84,1:21)*Se_F1-(M0*ones(84,1))];
tak_sal_tik2=[Fi(1:84,1:21)*Sr_previ-
ous+Fi(1:84,1:21)*Sr+Fi(1:84,1:21)*Se_F2-(M0*ones(84,1))];
tak_sal_tik3=[Fi(1:84,1:21)*Sr_previ-
ous+Fi(1:84,1:21)*Sr+Fi(1:84,1:21)*Se_F3-(M0*ones(84,1))];

tak_sal_tik=[tak_sal_tik1 tak_sal_tik2 tak_sal_tik3];

%takumo salygu reiksmiu suskirtymas pagal apkrovu veikimo srities
virsunes
for i=1:3; k=1:14; kt=i:3:42; kn=i+42:3:84;
 % 1-ai virsunei
   tst1(i,k)=tak_sal_tik1(kt); %teigiamos takumo salygu reiksmes
   tst2(i,k)=tak_sal_tik1(kn); %neigiamos takumo salygu reiksmes
 % 2-ai virsunei
   tst3(i,k)=tak_sal_tik2(kt);
   tst4(i,k)=tak_sal_tik2(kn);
 % 3-iai virsunei
   tst5(i,k)=tak_sal_tik3(kt);
   tst6(i,k)=tak_sal_tik3(kn);
end;

tst=[tst1;tst2;tst3;tst4;tst5;tst6];


% % Kinematines formuluotes rezultatai:
ur = lambda.eqlin;
plast_daug = lambda.ineqlin
Fi=[Fi(1:84,1:21);Fi(1:84,1:21);Fi(1:84,1:21)];
teta_p = Fi'*lambda.ineqlin
```

```
% ue=(A*inv(D)*A')^(-1);
% usum=ue+ur;

%lambda - plastiniu daugikliu surinkimas pagal taukumo salygas
for i=1:3; k=1:14; kt=i:3:42; kn=i+42:3:84;
 % 1-ai virsunei
   pld1(i,k)=plast_daug(kt); %teigiamos takumo salygu reiksmes
   pld2(i,k)=plast_daug(kn); %neigiamos takumo salygu reiksmes
end;

for i=1:3; k=1:14; kt=i+84:3:126; kn=i+126:3:168;
 % 2-ai virsunei
   pld3(i,k)=plast_daug(kt);
   pld4(i,k)=plast_daug(kn);
end;

for i=1:3; k=1:14; kt=i+168:3:210; kn=i+210:3:252;
    % 3-iai virsunei
   pld5(i,k)=plast_daug(kt);
   pld6(i,k)=plast_daug(kn);
end;

%Plastiniu daugikliu matricos sudarymas
pld=[pld1;pld2;pld3;pld4;pld5;pld6];

%influentines liekamuju dydziu matricos
G=((D^(-1))*A'*(A*(D^(-1))*A')^(-1))*A*(D^(-1))-(D^(-1));
H=((A*(D^(-1))*A')^(-1))*A*(D^(-1));

%patikirnimas per influentines liekamuju dydziu matricas ir plas-
tines
%deformacijas
% Mr_per_G=G*teta_p;
ur_per_H=H*teta_p;

% KOMANDOS REZULTATU SPAUSDINIMUI EXCEL FORMATU

%     xlswrite('Bendroji_an-
alize.xlsx',[Se_F1';Se_F2';Se_F3';Sr'],'S');
%     xlswrite('Bendroji_analize.xlsx',[tst;pld],'tak_sal ir
pld');
%     xlswrite('Bendroji_analize.xlsx',teta_p','teta_pl');


% lambda.ineqlin
% takums=[Me_max+Mr -Me_min-Mr]
teta_p
exitflag %isprendimo pozymis
```

Funkcinio failo „myfun.m“ programinis kodas

```
function F=myfun_scan_Premo(x)
global D %Sr_previous;

F=0.5*(x)'*D*(x);
```

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