

Program pro řešení soustavy diferenciálních rovnic metodou střelby

```
function [y, eta] = MetodaStrelby(odr_var, a, b, alpha1,alpha2, beta1,beta2,gamma1,gamma2, eta_0,
eps, maxiter, Lx)
% Reseni soustavy dvou obycejnych diferencialnich rovnic prvnioho radu na
% intervalu [a, b] metodou strelby.
% odr_var ... variacni rovnice
% alpha1*y1(a) + beta1*y2(a) = gamma1 ... pocatecni podminka
% alpha2*y1(b) + beta2*y2(b) = gamma2 ... koncova podminka
% eta_0 ... pocatecni odhad volene pocatecni podminky
% eps ... mez konvergence newtonovy metody
% maxiter ... maximalni pocet iteraci newtonovy metody

eta_old = eta_0;
delta = eps+1;
k = 0;
eta = 0;
fprintf(1,'k = %d, eta = %16.8e\n',k,eta_0);

while delta >= eps && k <= maxiter
    ic = [0,0,0,0];
    if (abs(beta1) < 1e-8)
        ic(2) = eta_old; ic(4) = 1;
        ic(1) = (gamma1-beta1*eta_old)/alpha1;
        ic(3) = -beta1/alpha1;
    else
        ic(1) = eta_old; ic(3) = 1;
        ic(2) = (gamma1-alpha1*eta_old)/beta1;
        ic(4) = -alpha1/beta1;
    end

    [~,y] = ode45(odr_var, Lx, ic);

    phi = alpha2*y(end,1)+ beta2*y(end,2)-gamma2;
    phi_der = alpha2*y(end,3)+ beta2*y(end,4);

    eta_new = eta_old - phi/phi_der;
    delta = abs(eta_new - eta_old);
    k = k + 1;
    fprintf(1,'k = %d, eta = %16.8e, delta = %16.8e\n',k,eta_new,delta);
    eta_old = eta_new;
end

if ((delta < eps) && (length(Lx) == length(y(:,1))))
    eta = eta_new;

    ic = [0,0,0,0];
    if (abs(beta1) < 1e-8)
        ic(2) = eta_old; ic(4) = 1;
        ic(1) = (gamma1-beta1*eta_old)/alpha1;
        ic(3) = -beta1/alpha1;
    else
        ic(1) = eta_old; ic(3) = 1;
        ic(2) = (gamma1-alpha1*eta_old)/beta1;
        ic(4) = -alpha1/beta1;
    end
end
```

```
[~,y] = ode45(odr_var, Lx, ic);

fprintf('Reseni: \n');
fprintf('  x      y1(x)      y2(x)\n');
for i = 1:(length(Lx))
    fprintf('%5.3f, %10.6f, %10.6f\n',Lx(i),y(i,1),y(i,2));
end

else
    fprintf('Metoda nekonverguje. Vycerpan maximalni pocet iteraci Newtonovy metody\n');
    y = [];
end

end

end
```

Definice pravé strany soustavy diferenciálních rovnic a pravé strany variačních rovnic

```
function dy = pri_var1(x,y)

dy = zeros(size(y));

dy(1) = y(2);
dy(2) = y(1)*y(1);
dy(3) = y(4);
dy(4) = 2*y(1)*y(3);

end
```

Použití programu MetodaStrelby na daný příklad:

```
% y''= y^2, y(0)=1, y(1)=1

% interval kde resime diferencialni rovnice
a = 0;
b = 1;

% okrajove podminky
alpha1 = 1;
alpha2 = 1;
beta1 = 0;
beta2 = 0;
gamma1 = 1;
gamma2 = 1;

% nastrel pocatecni podminky
eta_0 = 1;

% parametry pro Newtonovu metodu
eps = 1e-6;
maxiter = 100;

% body v nichz chci znat reseni
Lx = linspace(a,b,20);

[y, eta] = MetodaStrelby(@pri_var1,a, b, alpha1,alpha2, beta1,beta2,gamma1,gamma2, eta_0, eps,
maxiter, Lx);

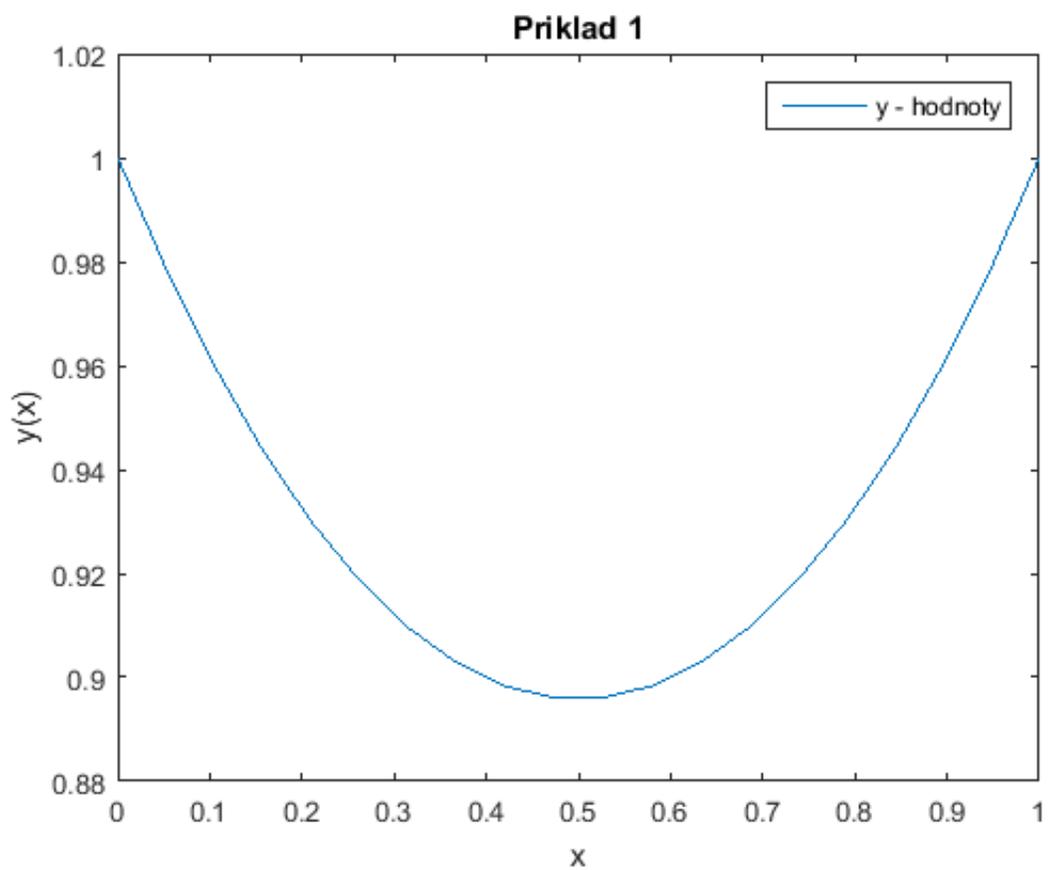
figure
    plot (Lx,y(:,1));
    legend('y - hodnoty');
    title('Příklad 1')
    xlabel('x')
    ylabel('y(x)')
figure
    plot(Lx,y(:,2));
    legend('y - derivace');
    title('Příklad 1')
    xlabel('x')
    ylabel('y''(x)')
```

```
k = 0, eta = 1.00000000e+00
k = 1, eta = -2.74359130e-01, delta = 1.27435913e+00
k = 2, eta = -4.30834594e-01, delta = 1.56475464e-01
k = 3, eta = -4.32935153e-01, delta = 2.10055824e-03
k = 4, eta = -4.32935525e-01, delta = 3.72571734e-07
```

Reseni:

x	y1(x)	y2(x)
0.000,	1.000000,	-0.432936
0.053,	0.978579,	-0.381447
0.105,	0.959811,	-0.332029
0.158,	0.943597,	-0.284378

0.211,	0.929851,	-0.238215
0.263,	0.918500,	-0.193281
0.316,	0.909488,	-0.149332
0.368,	0.902768,	-0.106135
0.421,	0.898307,	-0.063471
0.474,	0.896082,	-0.021122
0.526,	0.896082,	0.021122
0.579,	0.898307,	0.063471
0.632,	0.902768,	0.106135
0.684,	0.909488,	0.149332
0.737,	0.918500,	0.193281
0.789,	0.929851,	0.238215
0.842,	0.943597,	0.284378
0.895,	0.959811,	0.332029
0.947,	0.978579,	0.381447
1.000,	1.000000,	0.432936



Příklad 1

