Aplikační příklad 1.6

```
% y''= alpha * sinh(alpha * y),
% y(0)=0, y(1)=1

n = 100;
a = 0; b = 1;
alpha1 = 1;
alpha2 = 1;
beta1 = 0;
beta2 = 0;
gamma1 = 0;
gamma2 = 1;
y_init = [];
for i = 1:n+1;
    y_init(i) = (i-1)/n;
end
N_eps = 1e-6;
N_maxiter = 40;

fprintf('-------------------------------------------------\n');
fprintf('volba parametru: alpha = 0.8\n');

f = inline('0.8 * sinh(0.8 * y)','x','y','dy');
df2 = inline('0.8^2 * cosh(0.8 * y)','x','y','dy');
df3 = inline('0','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);
if (~isempty(y))
    figure
    plot (x,y,'DisplayName','alpha = 0.8');
    hold on;
end

fprintf('-------------------------------------------------\n');
fprintf('volba parametru: alpha = 1\n');

f = inline('1 * sinh(1 * y)','x','y','dy');
df2 = inline('1^2 * cosh(1 * y)','x','y','dy');
df3 = inline('0','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);
if (~isempty(y))
    plot (x,y,'DisplayName','alpha = 1');
    hold on;
end

fprintf('-------------------------------------------------\n');
fprintf('volba parametru: alpha = 2\n');

f = inline('2 * sinh(2 * y)','x','y','dy');
df2 = inline('2^2 * cosh(2 * y)','x','y','dy');
df3 = inline('0','x','y','dy');
```

```
[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);
if (~isempty(y))
    plot (x,y,'DisplayName','alpha = 2');
    hold on;
end

fprintf('-------------------------------------------------\n');
fprintf('volba parametru: alpha = 5\n');

f = inline('5 * sinh(5 * y)','x','y','dy');
df2 = inline('5^2 * cosh(5 * y)','x','y','dy');
df3 = inline('0','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);
if (~isempty(y))
    plot (x,y,'DisplayName','alpha = 5');
    hold on;
end

fprintf('-------------------------------------------------\n');
fprintf('volba parametru: alpha = 10\n');

f = inline('10 * sinh(10 * y)','x','y','dy');
df2 = inline('10^2 * cosh(10 * y)','x','y','dy');
df3 = inline('0','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);
if (~isempty(y))
    plot (x,y,'DisplayName','alpha = 10');
    hold on;
end

fprintf('-------------------------------------------------\n');
fprintf('volba parametru: alpha = 20\n');

f = inline('20 * sinh(20 * y)','x','y','dy');
df2 = inline('20^2 * cosh(20 * y)','x','y','dy');
df3 = inline('0','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);
if (~isempty(y))
    plot (x,y,'DisplayName','alpha = 20');
    xlabel('x');
    ylabel('y(x)');
    title('Sloupec plazmy stlacovane zarenim');
    legend('show','Location','northwest');

end
```

```
------------------------------------------------
volba parametru: alpha = 0.8
Iterace Newtonovy metody:
k = 1, error =   2.86987145e-01
k = 2, error =   1.03400764e-04
k = 3, error =   1.29969584e-11
Reseni:
   x      y(x)
0.000,   0.000000
0.010,   0.008981
0.020,   0.017963
0.030,   0.026946
0.040,   0.035931
0.050,   0.044918
0.060,   0.053908
0.070,   0.062901
0.080,   0.071898
0.090,   0.080900
0.100,   0.089907
0.110,   0.098920
0.120,   0.107940
0.130,   0.116966
0.140,   0.125999
0.150,   0.135041
0.160,   0.144092
0.170,   0.153151
0.180,   0.162221
0.190,   0.171301
0.200,   0.180391
0.210,   0.189494
0.220,   0.198609
0.230,   0.207736
0.240,   0.216877
0.250,   0.226031
0.260,   0.235201
0.270,   0.244385
0.280,   0.253585
0.290,   0.262802
0.300,   0.272035
0.310,   0.281286
0.320,   0.290555
0.330,   0.299843
0.340,   0.309150
0.350,   0.318477
0.360,   0.327825
0.370,   0.337194
0.380,   0.346585
0.390,   0.355999
0.400,   0.365435
0.410,   0.374895
0.420,   0.384380
0.430,   0.393889
0.440,   0.403425
0.450,   0.412986
0.460,   0.422574
```

0.470,   0.432190
0.480,   0.441834
0.490,   0.451507
0.500,   0.461210
0.510,   0.470943
0.520,   0.480706
0.530,   0.490501
0.540,   0.500329
0.550,   0.510189
0.560,   0.520083
0.570,   0.530011
0.580,   0.539974
0.590,   0.549972
0.600,   0.560007
0.610,   0.570079
0.620,   0.580189
0.630,   0.590337
0.640,   0.600525
0.650,   0.610752
0.660,   0.621020
0.670,   0.631329
0.680,   0.641681
0.690,   0.652075
0.700,   0.662514
0.710,   0.672996
0.720,   0.683524
0.730,   0.694098
0.740,   0.704718
0.750,   0.715386
0.760,   0.726102
0.770,   0.736868
0.780,   0.747683
0.790,   0.758549
0.800,   0.769467
0.810,   0.780437
0.820,   0.791460
0.830,   0.802538
0.840,   0.813670
0.850,   0.824858
0.860,   0.836103
0.870,   0.847406
0.880,   0.858767
0.890,   0.870187
0.900,   0.881668
0.910,   0.893210
0.920,   0.904814
0.930,   0.916481
0.940,   0.928213
0.950,   0.940009
0.960,   0.951871
0.970,   0.963800
0.980,   0.975798
0.990,   0.987864
1.000,   1.000000

```
volba parametru: alpha = 1
Iterace Newtonovy metody:
k = 1, error =   4.40444656e-01
k = 2, error =   5.77594736e-04
k = 3, error =   9.33455588e-10
Reseni:
   x      y(x)
0.000,   0.000000
0.010,   0.008452
0.020,   0.016905
0.030,   0.025360
0.040,   0.033817
0.050,   0.042278
0.060,   0.050743
0.070,   0.059213
0.080,   0.067689
0.090,   0.076171
0.100,   0.084661
0.110,   0.093160
0.120,   0.101668
0.130,   0.110187
0.140,   0.118716
0.150,   0.127257
0.160,   0.135811
0.170,   0.144379
0.180,   0.152961
0.190,   0.161558
0.200,   0.170172
0.210,   0.178803
0.220,   0.187451
0.230,   0.196119
0.240,   0.204806
0.250,   0.213514
0.260,   0.222244
0.270,   0.230996
0.280,   0.239771
0.290,   0.248570
0.300,   0.257395
0.310,   0.266245
0.320,   0.275123
0.330,   0.284028
0.340,   0.292962
0.350,   0.301926
0.360,   0.310920
0.370,   0.319946
0.380,   0.329005
0.390,   0.338097
0.400,   0.347224
0.410,   0.356386
0.420,   0.365584
0.430,   0.374820
0.440,   0.384094
0.450,   0.393408
0.460,   0.402761
0.470,   0.412157
```

```
0.480,   0.421594
0.490,   0.431075
0.500,   0.440601
0.510,   0.450172
0.520,   0.459789
0.530,   0.469455
0.540,   0.479168
0.550,   0.488932
0.560,   0.498747
0.570,   0.508613
0.580,   0.518533
0.590,   0.528506
0.600,   0.538535
0.610,   0.548621
0.620,   0.558764
0.630,   0.568966
0.640,   0.579228
0.650,   0.589552
0.660,   0.599938
0.670,   0.610387
0.680,   0.620901
0.690,   0.631482
0.700,   0.642130
0.710,   0.652846
0.720,   0.663633
0.730,   0.674491
0.740,   0.685422
0.750,   0.696426
0.760,   0.707506
0.770,   0.718663
0.780,   0.729898
0.790,   0.741213
0.800,   0.752609
0.810,   0.764087
0.820,   0.775650
0.830,   0.787298
0.840,   0.799033
0.850,   0.810857
0.860,   0.822771
0.870,   0.834777
0.880,   0.846877
0.890,   0.859071
0.900,   0.871363
0.910,   0.883753
0.920,   0.896244
0.930,   0.908836
0.940,   0.921533
0.950,   0.934335
0.960,   0.947245
0.970,   0.960265
0.980,   0.973396
0.990,   0.986640
1.000,   1.000000
--------------------------------------------------
volba parametru: alpha = 2
```

```
Iterace Newtonovy metody:
k = 1, error =   1.40879748e+00
k = 2, error =   7.50524776e-02
k = 3, error =   1.55252475e-04
k = 4, error =   6.55853006e-10
Reseni:
   x      y(x)
0.000,   0.000000
0.010,   0.005187
0.020,   0.010376
0.030,   0.015569
0.040,   0.020768
0.050,   0.025975
0.060,   0.031193
0.070,   0.036424
0.080,   0.041669
0.090,   0.046931
0.100,   0.052211
0.110,   0.057513
0.120,   0.062837
0.130,   0.068187
0.140,   0.073564
0.150,   0.078970
0.160,   0.084409
0.170,   0.089881
0.180,   0.095389
0.190,   0.100936
0.200,   0.106523
0.210,   0.112154
0.220,   0.117829
0.230,   0.123552
0.240,   0.129326
0.250,   0.135151
0.260,   0.141031
0.270,   0.146968
0.280,   0.152965
0.290,   0.159024
0.300,   0.165148
0.310,   0.171339
0.320,   0.177600
0.330,   0.183933
0.340,   0.190342
0.350,   0.196829
0.360,   0.203396
0.370,   0.210047
0.380,   0.216785
0.390,   0.223612
0.400,   0.230531
0.410,   0.237546
0.420,   0.244660
0.430,   0.251875
0.440,   0.259196
0.450,   0.266625
0.460,   0.274165
0.470,   0.281821
```

```
0.480,   0.289596
0.490,   0.297493
0.500,   0.305517
0.510,   0.313670
0.520,   0.321957
0.530,   0.330382
0.540,   0.338949
0.550,   0.347662
0.560,   0.356526
0.570,   0.365544
0.580,   0.374723
0.590,   0.384065
0.600,   0.393577
0.610,   0.403263
0.620,   0.413129
0.630,   0.423179
0.640,   0.433419
0.650,   0.443855
0.660,   0.454493
0.670,   0.465339
0.680,   0.476399
0.690,   0.487680
0.700,   0.499188
0.710,   0.510931
0.720,   0.522916
0.730,   0.535150
0.740,   0.547641
0.750,   0.560398
0.760,   0.573430
0.770,   0.586744
0.780,   0.600351
0.790,   0.614259
0.800,   0.628480
0.810,   0.643025
0.820,   0.657903
0.830,   0.673127
0.840,   0.688710
0.850,   0.704664
0.860,   0.721002
0.870,   0.737740
0.880,   0.754893
0.890,   0.772476
0.900,   0.790506
0.910,   0.809002
0.920,   0.827982
0.930,   0.847467
0.940,   0.867478
0.950,   0.888039
0.960,   0.909173
0.970,   0.930907
0.980,   0.953269
0.990,   0.976289
1.000,   1.000000
--------------------------------------------------
volba parametru: alpha = 5
```

```
Iterace Newtonovy metody:
k = 1, error =   1.65411192e+00
k = 2, error =   1.32526686e+00
k = 3, error =   7.74861998e-01
k = 4, error =   1.74805762e-01
k = 5, error =   5.77822249e-03
k = 6, error =   5.82562933e-06
k = 7, error =   6.12228343e-12
Reseni:
   x      y(x)
0.000,   0.000000
0.010,   0.000459
0.020,   0.000918
0.030,   0.001380
0.040,   0.001846
0.050,   0.002316
0.060,   0.002792
0.070,   0.003275
0.080,   0.003766
0.090,   0.004266
0.100,   0.004778
0.110,   0.005301
0.120,   0.005837
0.130,   0.006388
0.140,   0.006955
0.150,   0.007539
0.160,   0.008142
0.170,   0.008766
0.180,   0.009411
0.190,   0.010080
0.200,   0.010774
0.210,   0.011496
0.220,   0.012245
0.230,   0.013026
0.240,   0.013839
0.250,   0.014687
0.260,   0.015571
0.270,   0.016495
0.280,   0.017460
0.290,   0.018468
0.300,   0.019523
0.310,   0.020626
0.320,   0.021781
0.330,   0.022991
0.340,   0.024259
0.350,   0.025587
0.360,   0.026979
0.370,   0.028439
0.380,   0.029970
0.390,   0.031577
0.400,   0.033263
0.410,   0.035032
0.420,   0.036889
0.430,   0.038840
0.440,   0.040887
```

0.450,   0.043038
0.460,   0.045297
0.470,   0.047671
0.480,   0.050164
0.490,   0.052785
0.500,   0.055539
0.510,   0.058433
0.520,   0.061476
0.530,   0.064675
0.540,   0.068038
0.550,   0.071575
0.560,   0.075295
0.570,   0.079207
0.580,   0.083322
0.590,   0.087652
0.600,   0.092208
0.610,   0.097003
0.620,   0.102050
0.630,   0.107364
0.640,   0.112959
0.650,   0.118851
0.660,   0.125058
0.670,   0.131599
0.680,   0.138493
0.690,   0.145762
0.700,   0.153428
0.710,   0.161517
0.720,   0.170054
0.730,   0.179070
0.740,   0.188596
0.750,   0.198667
0.760,   0.209319
0.770,   0.220596
0.780,   0.232544
0.790,   0.245213
0.800,   0.258660
0.810,   0.272950
0.820,   0.288155
0.830,   0.304357
0.840,   0.321649
0.850,   0.340140
0.860,   0.359954
0.870,   0.381239
0.880,   0.404169
0.890,   0.428952
0.900,   0.455841
0.910,   0.485146
0.920,   0.517257
0.930,   0.552669
0.940,   0.592028
0.950,   0.636200
0.960,   0.686379
0.970,   0.744284
0.980,   0.812513
0.990,   0.895269

```
1.000,   1.000000
------------------------------------------------
volba parametru: alpha = 10
Iterace Newtonovy metody:
k = 1, error =   9.25438312e-01
k = 2, error =   8.74191231e-01
k = 3, error =   8.15915463e-01
k = 4, error =   7.49158430e-01
k = 5, error =   6.72066560e-01
k = 6, error =   5.78043204e-01
k = 7, error =   4.45938082e-01
k = 8, error =   2.32972835e-01
k = 9, error =   4.08339837e-02
k = 10, error =   8.69975806e-04
k = 11, error =   3.82988689e-07
Reseni:
   x      y(x)
0.000,   0.000000
0.010,   0.000004
0.020,   0.000007
0.030,   0.000011
0.040,   0.000015
0.050,   0.000019
0.060,   0.000024
0.070,   0.000028
0.080,   0.000033
0.090,   0.000038
0.100,   0.000044
0.110,   0.000050
0.120,   0.000056
0.130,   0.000063
0.140,   0.000071
0.150,   0.000079
0.160,   0.000088
0.170,   0.000098
0.180,   0.000109
0.190,   0.000121
0.200,   0.000135
0.210,   0.000149
0.220,   0.000166
0.230,   0.000183
0.240,   0.000203
0.250,   0.000225
0.260,   0.000249
0.270,   0.000275
0.280,   0.000304
0.290,   0.000336
0.300,   0.000372
0.310,   0.000411
0.320,   0.000455
0.330,   0.000503
0.340,   0.000556
0.350,   0.000614
0.360,   0.000679
0.370,   0.000750
```

0.380, 0.000829
0.390, 0.000916
0.400, 0.001013
0.410, 0.001119
0.420, 0.001237
0.430, 0.001367
0.440, 0.001511
0.450, 0.001670
0.460, 0.001845
0.470, 0.002039
0.480, 0.002254
0.490, 0.002491
0.500, 0.002753
0.510, 0.003042
0.520, 0.003362
0.530, 0.003716
0.540, 0.004106
0.550, 0.004538
0.560, 0.005015
0.570, 0.005542
0.580, 0.006125
0.590, 0.006769
0.600, 0.007481
0.610, 0.008267
0.620, 0.009137
0.630, 0.010098
0.640, 0.011160
0.650, 0.012334
0.660, 0.013631
0.670, 0.015065
0.680, 0.016651
0.690, 0.018404
0.700, 0.020341
0.710, 0.022484
0.720, 0.024853
0.730, 0.027474
0.740, 0.030373
0.750, 0.033580
0.760, 0.037129
0.770, 0.041058
0.780, 0.045410
0.790, 0.050231
0.800, 0.055576
0.810, 0.061505
0.820, 0.068090
0.830, 0.075409
0.840, 0.083555
0.850, 0.092638
0.860, 0.102786
0.870, 0.114152
0.880, 0.126925
0.890, 0.141335
0.900, 0.157680
0.910, 0.176340
0.920, 0.197831

```
0.930,   0.222868
0.940,   0.252495
0.950,   0.288327
0.960,   0.333067
0.970,   0.391768
0.980,   0.475601
0.990,   0.617571
1.000,   1.000000
-------------------------------------------------
volba parametru: alpha = 20
Iterace Newtonovy metody:
k = 1, error =   4.81102977e-01
k = 2, error =   4.69075325e-01
k = 3, error =   4.56114530e-01
k = 4, error =   4.42366612e-01
k = 5, error =   4.28042072e-01
k = 6, error =   4.13189377e-01
k = 7, error =   3.97775344e-01
k = 8, error =   3.81735043e-01
k = 9, error =   3.64979944e-01
k = 10, error =   3.47385601e-01
k = 11, error =   3.28754720e-01
k = 12, error =   3.08733083e-01
k = 13, error =   2.86704627e-01
k = 14, error =   2.61969723e-01
k = 15, error =   2.33856288e-01
k = 16, error =   1.99422346e-01
k = 17, error =   1.49658199e-01
k = 18, error =   7.12186679e-02
k = 19, error =   1.01958676e-02
k = 20, error =   1.52522572e-04
k = 21, error =   3.39564279e-08
Reseni:
   x      y(x)
0.000,   0.000000
0.010,   0.000000
0.020,   0.000000
0.030,   0.000000
0.040,   0.000000
0.050,   0.000000
0.060,   0.000000
0.070,   0.000000
0.080,   0.000000
0.090,   0.000000
0.100,   0.000000
0.110,   0.000000
0.120,   0.000000
0.130,   0.000000
0.140,   0.000000
0.150,   0.000000
0.160,   0.000000
0.170,   0.000000
0.180,   0.000000
0.190,   0.000000
0.200,   0.000000
```

0.210,   0.000000
0.220,   0.000000
0.230,   0.000000
0.240,   0.000000
0.250,   0.000000
0.260,   0.000000
0.270,   0.000000
0.280,   0.000000
0.290,   0.000000
0.300,   0.000000
0.310,   0.000000
0.320,   0.000000
0.330,   0.000000
0.340,   0.000000
0.350,   0.000001
0.360,   0.000001
0.370,   0.000001
0.380,   0.000001
0.390,   0.000001
0.400,   0.000001
0.410,   0.000002
0.420,   0.000002
0.430,   0.000003
0.440,   0.000003
0.450,   0.000004
0.460,   0.000005
0.470,   0.000006
0.480,   0.000007
0.490,   0.000009
0.500,   0.000011
0.510,   0.000013
0.520,   0.000016
0.530,   0.000020
0.540,   0.000024
0.550,   0.000029
0.560,   0.000036
0.570,   0.000043
0.580,   0.000053
0.590,   0.000065
0.600,   0.000079
0.610,   0.000096
0.620,   0.000118
0.630,   0.000144
0.640,   0.000176
0.650,   0.000214
0.660,   0.000262
0.670,   0.000320
0.680,   0.000390
0.690,   0.000477
0.700,   0.000582
0.710,   0.000711
0.720,   0.000868
0.730,   0.001059
0.740,   0.001294
0.750,   0.001579

```
0.760,   0.001929
0.770,   0.002355
0.780,   0.002875
0.790,   0.003511
0.800,   0.004287
0.810,   0.005235
0.820,   0.006392
0.830,   0.007806
0.840,   0.009533
0.850,   0.011644
0.860,   0.014225
0.870,   0.017383
0.880,   0.021250
0.890,   0.025993
0.900,   0.031824
0.910,   0.039015
0.920,   0.047929
0.930,   0.059069
0.940,   0.073160
0.950,   0.091339
0.960,   0.115572
0.970,   0.149794
0.980,   0.203970
0.990,   0.317238
1.000,   1.000000
```