```
> read "DESite.m":
```

Apl. pŠíklad 6:

Jednoduchý model chování sloupce plasmy stlaļované záŠením odvodil Troesch ve tvaru nelineární okrajové úlohy

$y''=\alpha \sinh \check{U}y$

y(0)=0 a y(1)=1.

Pouģijte parametry

1) $\check{U}=0,8$;
2) $\check{U}=1$;
3) $\alpha=2$;
4) $\alpha=5$;
5) $\alpha=10$;
6) $\alpha=20$.

1)

Definice parametrŢ diferenciální rovnice

```
> alpha:=0.8:
```

Definice pravé strany diferenciální rovnice

```
> f:=(x,y,dy)->alpha*sinh(alpha*y);
```

$$f := (x, y, dy) \rightarrow \alpha \sinh(\alpha y) \qquad \textbf{(1.1)}$$

Definice parametrŢ metody

```
> a := 0:
  b := 1:
  alfa1 := 1:
  alfa2 := 1:
  beta1 := 0:
  beta2 := 0:
  gama1 := 0:
  gama2 := 1:
  eps := 0.1e-5:
```

```
> n := 20:
  y0:=evalf([seq(0.5,i=1..n+1)]);
  y0[1]:=1.0;
  y0[n+1]:=1.0;
```

$y0 := [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5]$

$$y0_1 := 1.0$$

$$y0_{21} := 1.0 \qquad \textbf{(1.2)}$$

```
> yres := DESite2(n,f,a, b,alfa1,alfa2,beta1,beta2,gama1,
  gama2, eps, y0, 10):
```

"iterace = ", 0

"y = ", [0., 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 1.]

"iterace = ", 1, " s = ", 0.4940839359

"y = ", [0., 0.0450701097, 0.0901748246, 0.1353921631, 0.1808003382, 0.2264778932,

0.2725038373, 0.3189577823, 0.3659200802, 0.4134719626, 0.4616956807,
0.5106746479, 0.5604935838, 0.6112386610, 0.6629976542, 0.7158600916,
0.7699174102, 0.8252631140, 0.8819929353, 0.9402050006, 1.]

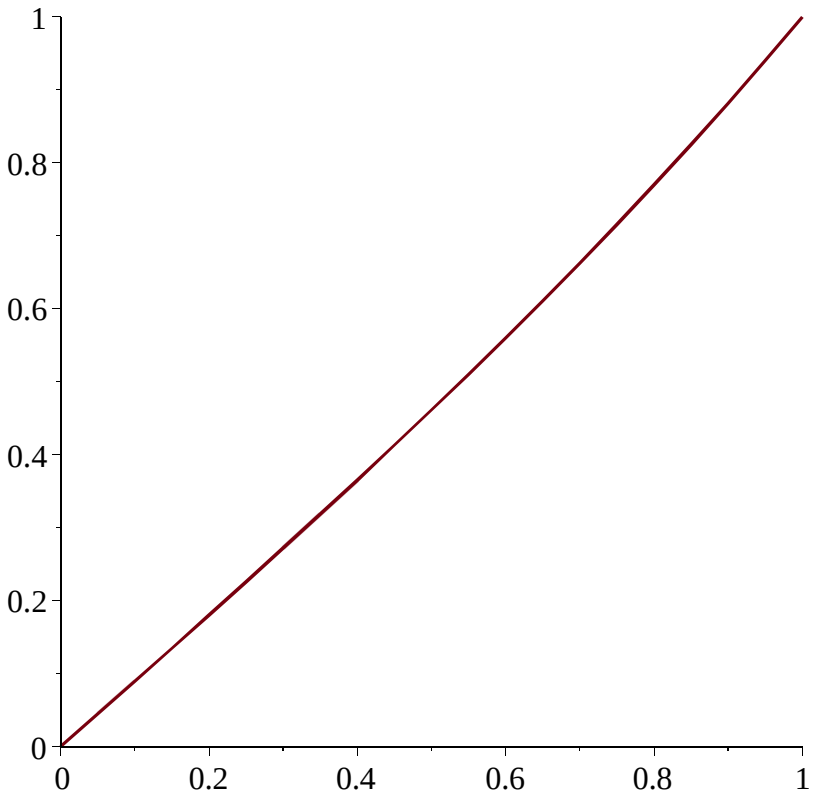
"iterace = ", 2, " s = ", 0.0007050440005

"y = ", [0., 0.04491903898, 0.08990996388, 0.1350448688, 0.1803962661,
0.2260373003, 0.2720419685, 0.3184853479, 0.3654438351, 0.4129953975,
0.4612198404, 0.5101990939, 0.5600175212, 0.6107622538, 0.6625235562,
0.7153952286, 0.7694750511, 0.8248652754, 0.8816731765, 0.9400116685, 1.]

"iterace = ", 3, " s = ", $1.749293497\ 10^{-9}$

"y = ", [0., 0.04491903881, 0.08990996354, 0.1350448683, 0.1803962654, **(1.3)**
0.2260372995, 0.2720419675, 0.3184853469, 0.3654438340, 0.4129953964,
0.4612198393, 0.5101990929, 0.5600175204, 0.6107622524, 0.6625235547,
0.7153952270, 0.7694750495, 0.8248652742, 0.8816731758, 0.9400116680, 1.]

```
> # Graf funkce yres(x)
> plot(yres);
```




```
> # Tabulka hodnot funkce yres(x)
> linalg[matrix](yres);
```

0.	0.
0.05000000000	0.04491903881
0.1000000000	0.08990996354
0.1500000000	0.1350448683
0.2000000000	0.1803962654
0.2500000000	0.2260372995
0.3000000000	0.2720419675
0.3500000000	0.3184853469
0.4000000000	0.3654438340
0.4500000000	0.4129953964
0.5000000000	0.4612198393
0.5500000000	0.5101990929
0.6000000000	0.5600175204
0.6500000000	0.6107622524
0.7000000000	0.6625235547
0.7500000000	0.7153952270
0.8000000000	0.7694750495
0.8500000000	0.8248652742
0.9000000000	0.8816731758
0.9500000000	0.9400116680
1.000000000	1.

(1.4)

2)

Definice parametrŢ diferenciální rovnice

```
> alpha:=1.0:
```

Definice pravé strany diferenciální rovnice

```
> f:=(x,y,dy)->alpha*sinh(alpha*y);
```

$$f := (x, y, dy) \rightarrow \alpha \sinh(\alpha y) \qquad \textbf{(2.1)}$$

Definice parametrŢ metody

```
> a := 0:
  b := 1:
  alfa1 := 1:
  alfa2 := 1:
  beta1 := 0:
  beta2 := 0:
  gama1 := 0:
  gama2 := 1:
  eps := 0.1e-5:
```

```
> n := 20:
  y0:=evalf([seq(0.5,i=1..n+1)]);
  y0[1]:=1.0;
```

```
   y0[n+1]:=1.0;
```

$y0 := [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5]$

$$y0_1 := 1.0$$

$$y0_{21} := 1.0 \qquad \textbf{(2.2)}$$

```
> yres := DESite2(n,f,a, b,alfa1,alfa2,beta1,beta2,gama1,
  gama2, eps, y0, 10):
```

"iterace = ", 0

"y = ", [0., 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 1.]

"iterace = ", 1, " s = ", 0.4937897728

"y = ", [0., 0.0426534892, 0.0853204272, 0.1281210949, 0.1711761501, 0.2146069679, 0.2585359826, 0.3030870327, 0.3483857106, 0.3945597162, 0.4417392170, 0.4900572152, 0.5396499223, 0.5906571434, 0.6432226712, 0.6974946912, 0.7536261999, 0.8117754355, 0.8721063246, 0.9347889440, 1.]

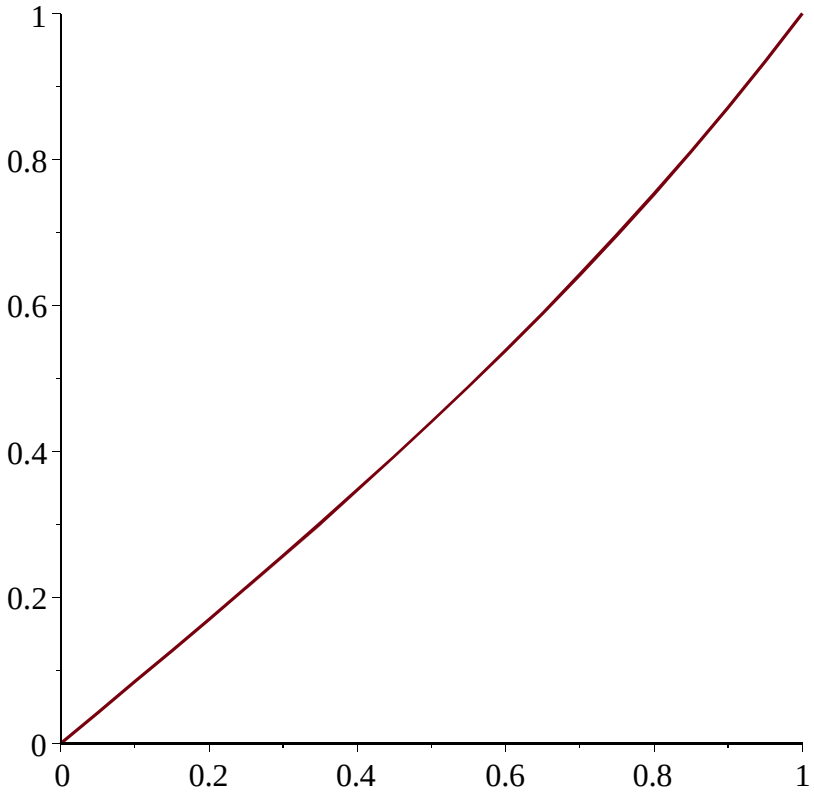
"iterace = ", 2, " s = ", 0.001688690040

"y = ", [0., 0.04228075968, 0.08466725274, 0.1272656669, 0.1701831046, 0.2135280566, 0.2574108942, 0.3019443889, 0.3472442666, 0.3934298059, 0.4406244902, 0.4889567273, 0.5385606490, 0.5895770091, 0.6421541981, 0.6964494019, 0.7526299340, 0.8108747765, 0.8713763758, 0.9343427531, 1.]

"iterace = ", 3, " s = ", $3.757770577\ 10^{-8}$

"y = ", [0., 0.04228075601, 0.08466724541, 0.1272656559, 0.1701830901, 0.2135280388, 0.2574108733, 0.3019443653, 0.3472442408, 0.3934297782, 0.4406244614, 0.4889566979, 0.5385606198, 0.5895769804, 0.6421541703, 0.6964493761, 0.7526299117, 0.8108747585, 0.8713763630, 0.9343427467, 1.] **(2.3)**

```
> # Graf funkce yres(x)
> plot(yres);
```




```
> # Tabulka hodnot funkce yres(x)
> linalg[matrix](yres);
```

(2.4)

0.	0.
0.05000000000	0.04228075601
0.1000000000	0.08466724541
0.1500000000	0.1272656559
0.2000000000	0.1701830901
0.2500000000	0.2135280388
0.3000000000	0.2574108733
0.3500000000	0.3019443653
0.4000000000	0.3472442408
0.4500000000	0.3934297782
0.5000000000	0.4406244614
0.5500000000	0.4889566979
0.6000000000	0.5385606198
0.6500000000	0.5895769804
0.7000000000	0.6421541703
0.7500000000	0.6964493761
0.8000000000	0.7526299117
0.8500000000	0.8108747585
0.9000000000	0.8713763630
0.9500000000	0.9343427467
1.000000000	1.

(2.4)

3)

Definice parametrŢ diferenciální rovnice

```
> alpha:=2.0:
```

Definice pravé strany diferenciální rovnice

```
> f:=(x,y,dy)->alpha*sinh(alpha*y);
```

$$f := (x, y, dy) \rightarrow \alpha \sinh(\alpha y) \qquad \textbf{(3.1)}$$

Definice parametrŢ metody

```
> a := 0:
  b := 1:
  alfa1 := 1:
  alfa2 := 1:
  beta1 := 0:
  beta2 := 0:
  gama1 := 0:
  gama2 := 1:
  eps := 0.1e-5:
```

```
> n := 20:
  y0:=evalf([seq(0.5,i=1..n+1)]);
  y0[1]:=1.0;
```

```
   y0[n+1]:=1.0;
```

$y0 := [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5]$

$$y0_1 := 1.0$$

$$y0_{21} := 1.0 \qquad \textbf{(3.2)}$$

```
> yres := DESite2(n,f,a, b,alfa1,alfa2,beta1,beta2,gama1,
  gama2, eps, y0, 10):
```

"iterace = ", 0

"y = ", [0., 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 1.]

"iterace = ", 1, " s = ", 0.5103249592

"y = ", [0., 0.0325620914, 0.0637872450, 0.0941572901, 0.1241408610, 0.1542006284, 0.1848004388, 0.2164124721, 0.2495245271, 0.2846475496, 0.3223235161, 0.3631337972, 0.4077081283, 0.4567343275, 0.5109689084, 0.5712487544, 0.6385040321, 0.7137725446, 0.7982157458, 0.8931366621, 1.]

"iterace = ", 2, " s = ", 0.02810272179

"y = ", [0., 0.02601074129, 0.05228168124, 0.07907623210, 0.1066644383, 0.1353266681, 0.1653576778, 0.1970711952, 0.2308052293, 0.2669283886, 0.3058476007, 0.3480177837, 0.3939542547, 0.4442490245, 0.4995926874, 0.5608045236, 0.6288749235, 0.7050268131, 0.7908073221, 0.8882294356, 1.]

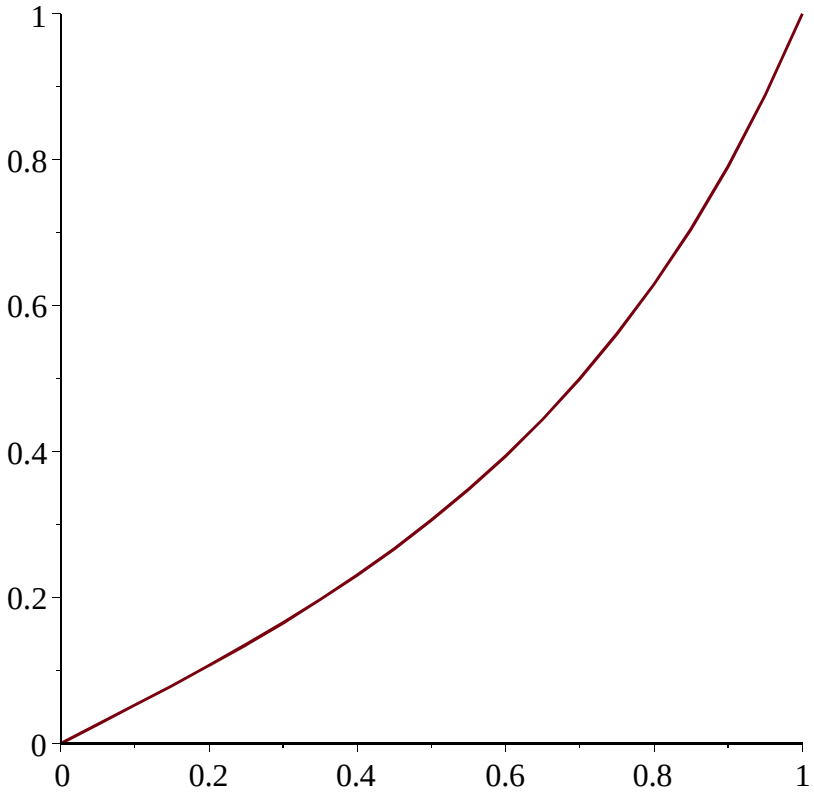
"iterace = ", 3, " s = ", 0.00007220015694

"y = ", [0., 0.02600393711, 0.05226803083, 0.07905575736, 0.1066373395, 0.1352933977, 0.1653189600, 0.1970279985, 0.2307587053, 0.2668797946, 0.3057982225, 0.3479688697, 0.3939069725, 0.4442044427, 0.4995517840, 0.5607682173, 0.6288441202, 0.7050024491, 0.7907903613, 0.8882207394, 1.]

"iterace = ", 4, " s = ", $2.418072162\ 10^{-9}$

"y = ", [0., 0.02600393702, 0.05226803065, 0.07905575711, 0.1066373392, 0.1352933972, 0.1653189593, 0.1970279977, 0.2307587043, 0.2668797935, 0.3057982212, 0.3479688683, 0.3939069710, 0.4442044410, 0.4995517822, 0.5607682154, 0.6288441186, 0.7050024476, 0.7907903598, 0.8882207385, 1.] **(3.3)**

```
> # Graf funkce yres(x)
> plot(yres);
```




```
> # Tabulka hodnot funkce yres(x)
> linalg[matrix](yres);
```

(3.4)

0.	0.
0.05000000000	0.02600393702
0.1000000000	0.05226803065
0.1500000000	0.07905575711
0.2000000000	0.1066373392
0.2500000000	0.1352933972
0.3000000000	0.1653189593
0.3500000000	0.1970279977
0.4000000000	0.2307587043
0.4500000000	0.2668797935
0.5000000000	0.3057982212
0.5500000000	0.3479688683
0.6000000000	0.3939069710
0.6500000000	0.4442044410
0.7000000000	0.4995517822
0.7500000000	0.5607682154
0.8000000000	0.6288441186
0.8500000000	0.7050024476
0.9000000000	0.7907903598
0.9500000000	0.8882207385
1.000000000	1.

(3.4)

4)

Definice parametrŢ diferenciální rovnice

```
> alpha:=5.0:
```

Definice pravé strany diferenciální rovnice

```
> f:=(x,y,dy)->alpha*sinh(alpha*y);
```

$$f := (x, y, dy) \rightarrow \alpha \sinh(\alpha y) \qquad \textbf{(4.1)}$$

Definice parametrŢ metody

```
> a := 0:
  b := 1:
  alfa1 := 1:
  alfa2 := 1:
  beta1 := 0:
  beta2 := 0:
  gama1 := 0:
  gama2 := 1:
  eps := 0.1e-5:
```

```
> n := 20:
  y0:=evalf([seq(0.5,i=1..n+1)]);
  y0[1]:=1.0;
```

```
   y0[n+1]:=1.0;
```

$$y0 := [0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5]$$

$$y0_{1} := 1.0$$

$$y0_{21} := 1.0 \qquad \textbf{(4.2)}$$

```
> yres := DESite2(n,f,a, b,alfa1,alfa2,beta1,beta2,gama1,
  gama2, eps, y0, 10):
```

"iterace = ", 0

"y = ", [0., 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, 1.]

"iterace = ", 1, " s = ", 0.3722135904

"y = ", [0., 0.1381566055, 0.2132577396, 0.2540872709, 0.2762938559, 0.2883885699, 0.2950069308, 0.2986855452, 0.3008343087, 0.3022767737, 0.3035657910, 0.3051953997, 0.3077901768, 0.3123446175, 0.3206042938, 0.3357348761, 0.3635354338, 0.4146610335, 0.5087064863, 0.6817164136, 1.]

"iterace = ", 2, " s = ", 0.3605585608

"y = ", [0., 0.0205662530, 0.0412968516, 0.0605706282, 0.0771141751, 0.0906260933, 0.1014943932, 0.1104356223, 0.1182866556, 0.1259358252, 0.1343419939, 0.1446069567, 0.1580870376, 0.1765458623, 0.2023674118, 0.2388809540, 0.2909352355, 0.3661207129, 0.4779626318, 0.6565412032, 1.]

"iterace = ", 3, " s = ", 0.1629860166

"y = ", [0., 0.00298541073, 0.00615386154, 0.00967831872, 0.01371881849, 0.01843886610, 0.02403600850, 0.03077433736, 0.03901369032, 0.04923790729, 0.06208789566, 0.07840651916, 0.09930441477, 0.1262615997, 0.1612939545, 0.2072484604, 0.2683818098, 0.3516420306, 0.4699907696, 0.6532222096, 1.]

"iterace = ", 4, " s = ", 0.009681845271

"y = ", [0., 0.002405857054, 0.004962083067, 0.007828464702, 0.01118422609, 0.01523930134, 0.02024761571, 0.02652331296, 0.03446116462, 0.04456290179, 0.05747210140, 0.07402192413, 0.09530327938, 0.1227678077, 0.1583950733, 0.2049886953, 0.2667570965, 0.3505991749, 0.4694321163, 0.6530160464, 1.]

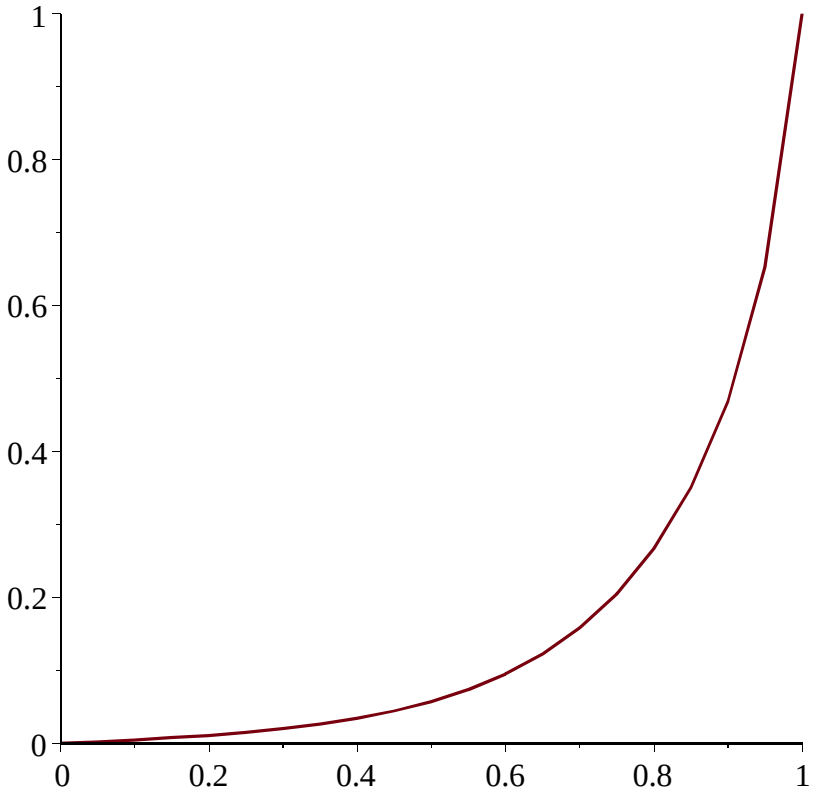
"iterace = ", 5, " s = ", 0.00002068110267

"y = ", [0., 0.002405177328, 0.004960681861, 0.007826260803, 0.01118110588, 0.01523513415, 0.02024227947, 0.02651672832, 0.03445333240, 0.04455393589, 0.05746224933, 0.07401156790, 0.09529291133, 0.1227579799, 0.1583863245, 0.2049814670, 0.2667516564, 0.3505955658, 0.4694301451, 0.6530153163, 1.]

"iterace = ", 6, " s = ", $2.735461812\ 10^{-10}$

"y = ", [0., 0.002405177317, 0.004960681840, 0.007826260768, 0.01118110584, 0.01523513411, 0.02024227942, 0.02651672826, 0.03445333234, 0.04455393581, 0.05746224924, 0.07401156782, 0.09529291123, 0.1227579798, 0.1583863243, 0.2049814669, 0.2667516563, 0.3505955657, 0.4694301450, 0.6530153162, 1.] **(4.3)**

```
> # Graf funkce yres(x)
> plot(yres);
```




```
> # Tabulka hodnot funkce yres(x)
> linalg[matrix](yres);
```

(4.4)

0.	0.
0.05000000000	0.002405177317
0.1000000000	0.004960681840
0.1500000000	0.007826260768
0.2000000000	0.01118110584
0.2500000000	0.01523513411
0.3000000000	0.02024227942
0.3500000000	0.02651672826
0.4000000000	0.03445333234
0.4500000000	0.04455393581
0.5000000000	0.05746224924
0.5500000000	0.07401156782
0.6000000000	0.09529291123
0.6500000000	0.1227579798
0.7000000000	0.1583863243
0.7500000000	0.2049814669
0.8000000000	0.2667516563
0.8500000000	0.3505955657
0.9000000000	0.4694301450
0.9500000000	0.6530153162
1.000000000	1.

(4.4)

5)

Definice parametrŢ diferenciální rovnice

```
> alpha:=10.0:
```

Definice pravé strany diferenciální rovnice

```
> f:=(x,y,dy)->alpha*sinh(alpha*y);
```

$$f := (x, y, dy) \rightarrow \alpha \sinh(\alpha y) \qquad \textbf{(5.1)}$$

Definice parametrŢ metody

```
> a := 0:
  b := 1:
  alfa1 := 1:
  alfa2 := 1:
  beta1 := 0:
  beta2 := 0:
  gama1 := 0:
  gama2 := 1:
  eps := 0.1e-5:
> n := 20:
```

```
y0:=evalf([seq(0.05*(i-1),i=1..n+1)]);
y0[1]:=1.0;
y0[n+1]:=1.0;
```

$y0$:= [0., 0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00]

$$y0_1 := 1.0$$

$$y0_{21} := 1.0 \qquad \textbf{(5.2)}$$

```
> yres := DESite2(n,f,a, b,alfa1,alfa2,beta1,beta2,gama1,
  gama2, eps, y0, 12):
```

"iterace = ", 0

"y = ", [0., 0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.]

"iterace = ", 1, " s = ", 0.1527401391

"y = ", [0., 0.01890602879, 0.04207384791, 0.07227551599, 0.1099992146, 0.1537442816, 0.2011774784, 0.2503296122, 0.3000924624, 0.3500286676, 0.4000097598, 0.4500034734, 0.5000012569, 0.5500004582, 0.6000001677, 0.6500000615, 0.7000000225, 0.7500000084, 0.8000000620, 0.8500598110, 1.]

"iterace = ", 2, " s = ", 0.1650281277

"y = ", [0., 0.00740443546, 0.01663664531, 0.02976988918, 0.04906190141, 0.07632617317, 0.1119571671, 0.1544990020, 0.2014082629, 0.2503888044, 0.3001071755, 0.3500328281, 0.4000111199, 0.4500039505, 0.5000014286, 0.5500005205, 0.6000001904, 0.6500000747, 0.7000011091, 0.7503839267, 1.]

"iterace = ", 3, " s = ", 0.1775390678

"y = ", [0., 0.002824520476, 0.00635372286, 0.01145491039, 0.01932584707, 0.03161346491, 0.05029468787, 0.07706076025, 0.1123165534, 0.1546363676, 0.2014488704, 0.2503985658, 0.3001093980, 0.3500334146, 0.4000113065, 0.4500040154, 0.5000014548, 0.5500006892, 0.6000134237, 0.6516914513, 1.]

"iterace = ", 4, " s = ", 0.1888408820

"y = ", [0., 0.001058031390, 0.002380488350, 0.004297130702, 0.00728256963, 0.01206238157, 0.01974380792, 0.03191149069, 0.05050061984, 0.07718590390, 0.1123780797, 0.1546596591, 0.2014555807, 0.2504001050, 0.3001097275, 0.3500335123, 0.4000115408, 0.4500082461, 0.5001339278, 0.5562753541, 1.]

"iterace = ", 5, " s = ", 0.1955108295

"y = ", [0., 0.0003938893704, 0.000886246725, 0.001600116118, 0.002713722578, 0.004504339185, 0.00741459581, 0.01215036039, 0.01980612265, 0.03195745465, 0.05053329732, 0.07720610685, 0.1123880958, 0.1546635405, 0.2014570635, 0.2504021104, 0.3001201644, 0.3501220458, 0.4011269791, 0.4704119495, 1.]

"iterace = ", 6, " s = ", 0.1896648579

"y = ", [0., 0.0001464550534, 0.0003295236448, 0.000594970582, 0.001009145067, 0.001675532169, 0.002760465596, 0.004534014539, 0.00743447426, 0.01216512606, 0.01981891867, 0.03197057515, 0.05054910523, 0.07722919338, 0.1124309417, 0.1547657992, 0.2017732123, 0.2517030032, 0.3074369976, 0.4062850061, 1.]

"iterace = ", 7, " s = ", 0.1551747785

"y = ", [0., 0.00005553234705, 0.0001249477696, 0.0002256000060, 0.0003826514869, 0.000635362146, 0.001046896438, 0.001720079258,

0.002822947086, 0.004630076761, 0.00758827639, 0.01241579731,
0.02023214574, 0.03266250678, 0.05174470343, 0.07942791158, 0.1169386978,
0.1656355347, 0.2340364774, 0.3733747380, 1.]

"iterace = ", 8, " s = ", 0.07533671712

"y = ", [0., 0.00002857462363, 0.00006429290284, 0.0001160844041,
0.0001968969846, 0.0003269337047, 0.0005387033635, 0.0008851466820,
0.001452866997, 0.002383761311, 0.003910407519, 0.006413828241,
0.01051710678, 0.01723436111, 0.02819859483, 0.04599173058, 0.07465920379,
0.1210360699, 0.2002522169, 0.3638145671, 1.]

"iterace = ", 9, " s = ", 0.01043332728

"y = ", [0., 0.00002562214956, 0.00005764983658, 0.0001040899836,
0.0001765526310, 0.0002931534581, 0.0004830427502, 0.0007936931792,
0.001302768896, 0.002137545656, 0.003506747780, 0.005752808848,
0.009437831693, 0.01548566859, 0.02541977491, 0.04177482023, 0.06886975083,
0.1145425814, 0.1954580570, 0.3627624338, 1.]

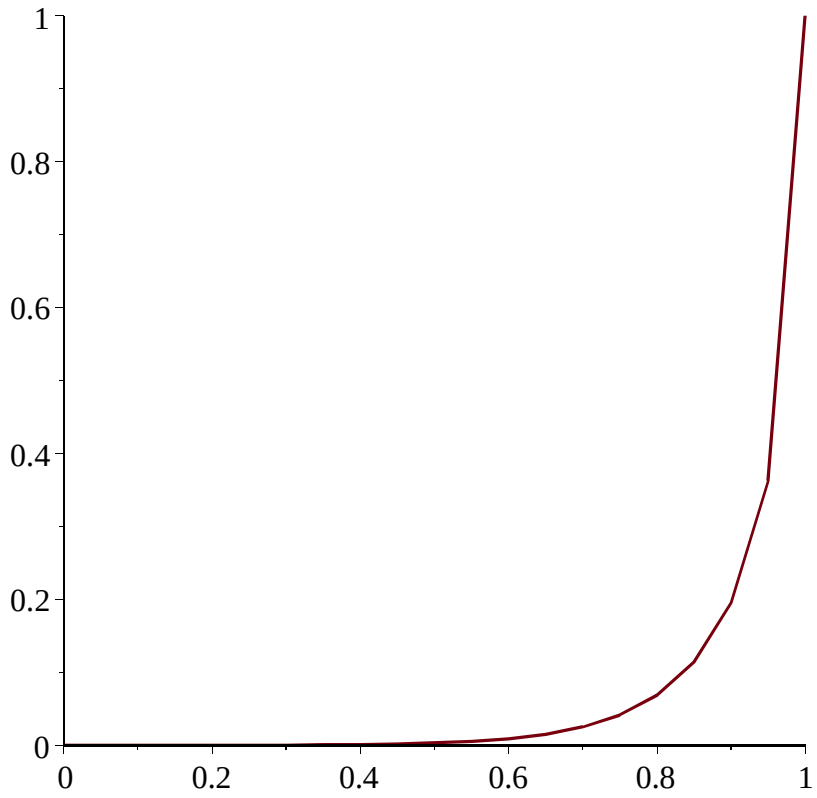
"iterace = ", 10, " s = ", 0.0001473653115

"y = ", [0., 0.00002558565427, 0.00005756772219, 0.0001039417215,
0.0001763011558, 0.0002927359019, 0.0004823547280, 0.0007925627037,
0.001300913430, 0.002134501687, 0.003501755886, 0.005744627983,
0.009424447108, 0.01546386738, 0.02538468073, 0.04172003976, 0.06879061918,
0.1144476687, 0.1953847875, 0.3627476021, 1.]

"iterace = ", 11, " s = ", $2.954991519\ 10^{-8}$

"y = ", [0., 0.00002558564754, 0.00005756770704, 0.0001039416941, **(5.3)**
0.0001763011094, 0.0002927358248, 0.0004823546010, 0.0007925624950,
0.001300913087, 0.002134501123, 0.003501754962, 0.005744626468,
0.009424444627, 0.01546386334, 0.02538467419, 0.04172002942, 0.06879060385,
0.1144476494, 0.1953847718, 0.3627475990, 1.]

```
> # Graf funkce yres(x)
> plot(yres);
```




```
> # Tabulka hodnot funkce yres(x)
> linalg[matrix](yres);
```

(5.4)

0.	0.
0.05000000000	0.00002558564754
0.1000000000	0.00005756770704
0.1500000000	0.0001039416941
0.2000000000	0.0001763011094
0.2500000000	0.0002927358248
0.3000000000	0.0004823546010
0.3500000000	0.0007925624950
0.4000000000	0.001300913087
0.4500000000	0.002134501123
0.5000000000	0.003501754962
0.5500000000	0.005744626468
0.6000000000	0.009424444627
0.6500000000	0.01546386334
0.7000000000	0.02538467419
0.7500000000	0.04172002942
0.8000000000	0.06879060385
0.8500000000	0.1144476494
0.9000000000	0.1953847718
0.9500000000	0.3627475990
1.000000000	1.

(5.4)

6)

Definice parametrŢ diferenciální rovnice

```
> alpha:=20.0:
```

Definice pravé strany diferenciální rovnice

```
> f:=(x,y,dy)->alpha*sinh(alpha*y);
```

$$f := (x, y, dy) \rightarrow \alpha \sinh(\alpha y) \qquad \textbf{(5.1.1)}$$

Definice parametrŢ metody

```
> a := 0:
  b := 1:
  alfa1 := 1:
  alfa2 := 1:
  beta1 := 0:
  beta2 := 0:
  gama1 := 0:
  gama2 := 1:
  eps := 0.1e-5:
```

```
> n := 20:
  y0:=evalf([seq(0.05*(i-1),i=1..n+1)]);
  y0[1]:=1.0;
  y0[n+1]:=1.0;
```

$y0 := [0., 0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.00]$

$$y0_1 := 1.0$$

$$y0_{21} := 1.0 \qquad \textbf{(5.1.2)}$$

```
> yres := DESite2(n,f,a, b,alfa1,alfa2,beta1,beta2,gama1,
  gama2, eps, y0, 15):
```

"iterace = ", 0

"y = ", [0., 0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95, 1.]

"iterace = ", 1, " s = ", 0.07948413427

"y = ", [0., 0.02067789060, 0.05486946169, 0.1006141364, 0.1500523756, 0.2000051162, 0.2500006339, 0.3000000840, 0.3500000113, 0.4000000015, 0.4500000002, 0.5000000001, 0.5500000000, 0.6000000000, 0.6500000000, 0.7000000000, 0.7500000000, 0.8000000000, 0.8500000000, 0.9000000006, 1.]

"iterace = ", 2, " s = ", 0.08280931173

"y = ", [0., 0.00824664752, 0.02425613105, 0.05585807640, 0.1007396918, 0.1500614432, 0.2000058535, 0.2500007207, 0.3000000954, 0.3500000128, 0.4000000017, 0.4500000003, 0.5000000001, 0.5500000000, 0.6000000000, 0.6500000000, 0.7000000000, 0.7500000000, 0.8000000000, 0.8500000036, 1.]

"iterace = ", 3, " s = ", 0.08621989308

"y = ", [0., 0.003224181341, 0.00964151590, 0.02490932345, 0.05604551833, 0.1007627562, 0.1500629194, 0.2000059575, 0.2500007326, 0.3000000970, 0.3500000130, 0.4000000018, 0.4500000003, 0.5000000001, 0.5500000000, 0.6000000000, 0.6500000000, 0.7000000000, 0.7500000000, 0.8000000160, 1.]

"iterace = ", 4, " s = ", 0.08969677006

"y = ", [0., 0.001240559678, 0.003719788413, 0.00986823075, 0.02502269151, 0.05607874550, 0.1007667346, 0.1500631523, 0.2000059722, 0.2500007342, 0.3000000972, 0.3500000131, 0.4000000018, 0.4500000003, 0.5000000001, 0.5500000000, 0.6000000000, 0.6500000000, 0.7000000000, 0.7500000610, 1.]

"iterace = ", 5, " s = ", 0.09323633266

"y = ", [0., 0.0004746562003, 0.001423860130, 0.003793999874, 0.00990364160, 0.02504142834, 0.05608433041, 0.1007673906, 0.1500631884, 0.2000059742, 0.2500007344, 0.3000000972, 0.3500000131, 0.4000000018, 0.4500000003, 0.5000000001, 0.5500000000, 0.6000000000, 0.6500000000, 0.7000002140, 1.]

"iterace = ", 6, " s = ", 0.09679172485

"y = ", [0., 0.0001813628489, 0.0005440824600, 0.001450720233, 0.003804970847, 0.00990905172, 0.02504442224, 0.05608523430, 0.1007674954, 0.1500631939, 0.2000059745, 0.2500007344, 0.3000000972, 0.3500000131, 0.4000000018, 0.4500000003, 0.5000000001, 0.5500000000, 0.6000000000, 0.6500007129, 1.]

"iterace = ", 7, " s = ", 0.1002713315

"y = ", [0., 0.0000692785867, 0.0002078354204, 0.0005542185041, 0.001454646265, 0.003806585069, 0.00990986849, 0.02504488986, 0.05608537677, 0.1007675117, 0.1500631947, 0.2000059745, 0.2500007344, 0.3000000972, 0.3500000131, 0.4000000018, 0.4500000003, 0.5000000001, 0.5500000000, 0.6000022951, 1.]

"iterace = ", 8, " s = ", 0.1035360464

"y = ", [0., 0.00002646233671, 0.0000793869912, 0.0002116981258, 0.0005556976934, 0.001455219704, 0.003806822080, 0.00990999087, 0.02504496175, 0.05608539881, 0.1007675142, 0.1500631948, 0.2000059745, 0.2500007344, 0.3000000972, 0.3500000131, 0.4000000018, 0.4500000003, 0.5000000003, 0.5500072101, 1.]

"iterace = ", 9, " s = ", 0.1063901861

"y = ", [0., 0.00001010773044, 0.00003032319026, 0.0000808618119, 0.0002122617053, 0.0005559135335, 0.001455303436, 0.003806856829, 0.00991000909, 0.02504497266, 0.05608540218, 0.1007675146, 0.1500631948, 0.2000059745, 0.2500007344, 0.3000000972, 0.3500000131, 0.4000000018, 0.4500000025, 0.5000222380, 1.]

"iterace = ", 10, " s = ", 0.1085710459

"y = ", [0., 0.000003860810565, 0.00001158243164, 0.00003088648276, 0.0000810769865, 0.0002123439321, 0.0005559450275, 0.001455315659, 0.003806861916, 0.00991001179, 0.02504497427, 0.05608540267, 0.1007675146, 0.1500631948, 0.2000059745, 0.2500007344, 0.3000000972, 0.3500000131, 0.4000000207, 0.4500676056, 1.]

"iterace = ", 11, " s = ", 0.1097400536

"y = ", [0., 0.000001474698480, 0.000004424095439, 0.00001179758775, 0.00003096866611, 0.0000811083802, 0.0002123559294, 0.0005559496241, 0.001455317448, 0.003806862668, 0.00991001220, 0.02504497455, 0.05608540271, 0.1007675146, 0.1500631948, 0.2000059745, 0.2500007344, 0.3000000975, 0.3500001680, 0.4002030744, 1.]

"iterace = ", 12, " s = ", 0.1094716012

"y = ", [0., $5.632847005\ 10^{-7}$, 0.000001689854101, 0.000004506277597, 0.00001182897859, 0.00003098065650, 0.0000811129605, 0.0002123576798, 0.0005559502943, 0.001455317707, 0.003806862773, 0.00991001225, 0.02504497456, 0.05608540271, 0.1007675146, 0.1500631948, 0.2000059745, 0.2500007409, 0.3000013477, 0.3506032038, 1.]

"iterace = ", 13, " s = ", 0.1072127964

"y = ", [0., $2.151556093\ 10^{-7}$, $6.45466828\ 10^{-7}$, 0.000001721244875, 0.000004518267792, 0.00001183355840, 0.00003098240572, 0.0000811136284, 0.0002123579343, 0.0005559503908, 0.001455317743, 0.003806862785, 0.00991001226, 0.02504497458, 0.05608540278, 0.1007675150, 0.1500631995, 0.2000061110, 0.2500106522, 0.3017681623, 1.]

"iterace = ", 14, " s = ", 0.1021278150

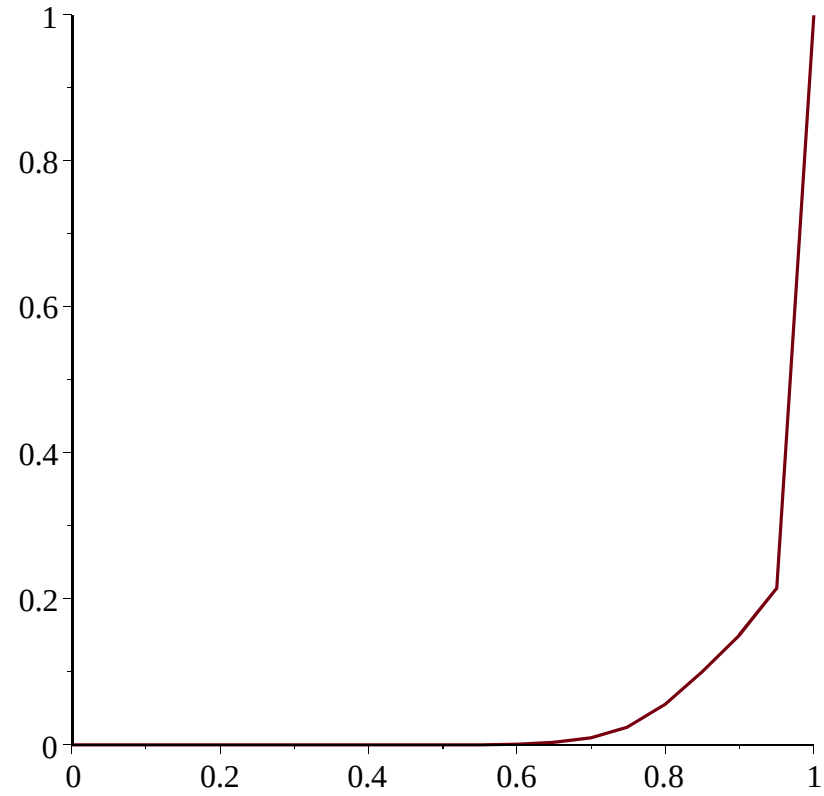
"y = ", [0., $8.21821677\ 10^{-8}$, $2.465465031\ 10^{-7}$, $6.57457342\ 10^{-7}$, 0.000001725825522, 0.000004520019220, 0.00001183423204, 0.00003098267519, 0.0000811137632, 0.0002123580692, 0.0005559506609, 0.001455318419, 0.003806864547, 0.00991001690, 0.02504498733, 0.05608544532, 0.1007677484, 0.1500659293, 0.2000821728, 0.2550702622, 1.]

"iterace = ", 15, " s = ", 0.09265996788

"y = ", [0., $3.139380844\ 10^{-8}$, $9.41814253\ 10^{-8}$, $2.511504677\ 10^{-7}$, $6.59269978\ 10^{-7}$,
0.000001726659465, 0.000004520708413, 0.00001183546568,
0.00003098568695, 0.0000811215648, 0.0002123784622, 0.0005560040390,
0.001455458182, 0.003807230859, 0.00991098317, 0.02504764160,
0.05609425795, 0.1008156004, 0.1506082141, 0.2138754215, 1.]

"Vyļerpán maximální poļet iterací, poļet iterací = ", 15 **(5.1.3)**

```
> # Graf funkce yres(x)
> plot(yres);
```




```
> # Tabulka hodnot funkce yres(x)
> linalg[matrix](yres);
```

0.	0.
0.05000000000	$3.139380844\ 10^{-8}$
0.1000000000	$9.41814253\ 10^{-8}$
0.1500000000	$2.511504677\ 10^{-7}$
0.2000000000	$6.59269978\ 10^{-7}$
0.2500000000	0.000001726659465
0.3000000000	0.000004520708413
0.3500000000	0.00001183546568
0.4000000000	0.00003098568695
0.4500000000	0.0000811215648
0.5000000000	0.0002123784622
0.5500000000	0.0005560040390
0.6000000000	0.001455458182
0.6500000000	0.003807230859
0.7000000000	0.00991098317
0.7500000000	0.02504764160
0.8000000000	0.05609425795
0.8500000000	0.1008156004
0.9000000000	0.1506082141
0.9500000000	0.2138754215
1.000000000	1.

(5.1.4)