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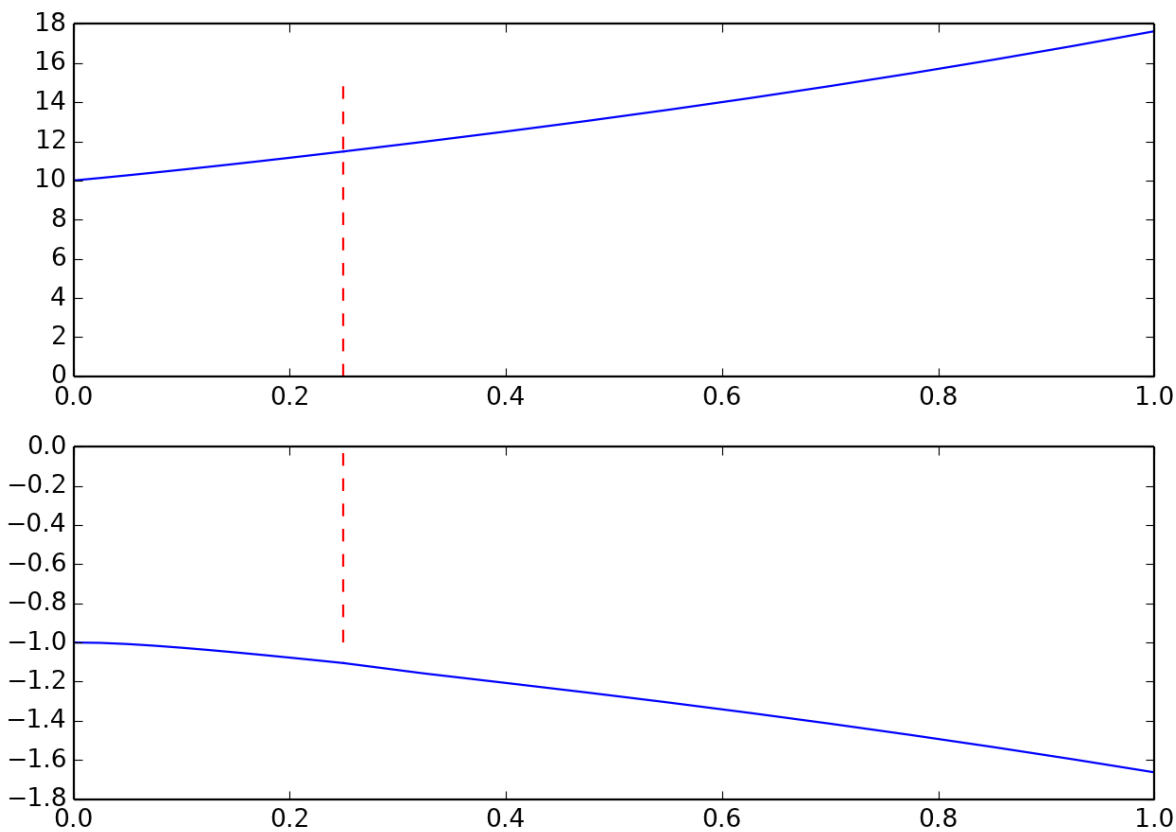
1  #coding: utf-8
2  import math
3  import numpy as np
4  import matplotlib.pyplot as plt
5
6  eps = 0.000001
7  A = -10000
8  n = 10
9  x_pogr = abs(5.0 / A)
10 h1 = x_pogr / n
11 h2 = (1.0 - x_pogr) / n
12 gamma = (3 + math.sqrt(3)) / 6.0
13 agh1 = A * gamma * h1
14 agh2 = A * gamma * h2
15 znam1 = agh1 - 1
16 znam2 = agh2 - 1
17
18
19 def findK1(x, y, z, h, agh, znam):
20     tmp = ((1.5 - 2*agh/znam)*y + (agh/znam - 1)*A*z + agh/znam * ost(x + (gamma)*h)) / (1 + 2*gamma*h*agh/znam -
21     1.5*gamma*h)
22     k0 = 0
23     k = tmp
24     while abs(k - k0) > eps:
25         k0 = k
26         k = tmp + math.sqrt((y + gamma*h*k)**2 + 1) / (1 + 2*gamma*h*agh/znam - 1.5*gamma*h)
27     return k
28
29 def findK2(x, y, z, k1, l1, h, agh, znam):
30     tmp = ((1.5 - 2*agh/znam)*(y + h*(1-2*gamma)*k1) + (agh/znam - 1)*A*(z + h*(1-2*gamma)*l1) - agh/znam * ost(x +
31     (1-gamma)*h)) / (1 + 2*gamma*h*agh/znam - 1.5*gamma*h)
32     k0 = 0
33     k = tmp
34     while abs(k - k0) > eps:
35         k0 = k
36         k = tmp + math.sqrt((y + h*(1-2*gamma)*k1 + gamma*h*k)**2 + 1) / (1 + 2*gamma*h*agh/znam - 1.5*gamma*h)
37     return k
38
39 def ost(x):
40     return x * math.sqrt(x**2 + 1)
41
42 def resh(mode, x):
43     for i in range(1, n + 1):
44         h = h1 if (mode == 'pogr') else h2
45         agh = agh1 if (mode == 'pogr') else agh2
46         znam = znam1 if (mode == 'pogr') else znam2
47
48         x += h
49         k1 = findK1(x, y[-1], z[-1], h, agh, znam)
50         l1 = (2 * (y[-1] + gamma * h * k1) - A * z[-1] - ost(x + (gamma)*h)) / znam
51         k2 = findK2(x, y[-1], z[-1], k1, l1, h, agh, znam)
52         l2 = (2*y[-1] + 2*h*(1-2*gamma)*k1 + 2*h*gamma*k2 - A*z[-1] - A*h*(1-2*gamma)*l1 - ost(x + (1-gamma)*h)) /
53         znam
54         y.append(y[-1] + h / 2 * (k1 + k2))
55         z.append(z[-1] + h / 2 * (l1 + l2))
56         print 'y[' , i , ']' = ' , y[-1] , ';' , z[' , i , ']' = ' , z[-1]
57
58 y = []; y.append(10)
59 z = []; z.append(-1)
60
61 x = 0
62 print 'A =', A
63 print
64 print 'Пограничный слой:'
65 resh('pogr', x)
66 print 'Основная сетка:'
67 resh('rest', x)
68
69 plt.figure(1)
70 plt.subplot(211)
71 plt.plot([i * h1 for i in range(n+1)], y[:n+1], 'b-', [x_pogr, x_pogr], [0, 15], 'r--', [x_pogr + i * h2 for i in
72 range(n+1)], y[n:], 'b-')
73 plt.subplot(212)
74 plt.plot([i * h1 for i in range(n+1)], z[:n+1], 'b-', [x_pogr, x_pogr], [-1, 0], 'r--', [x_pogr + i * h2 for i in
75 range(n+1)], z[n:], 'b-')
76 plt.show()

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A = -20

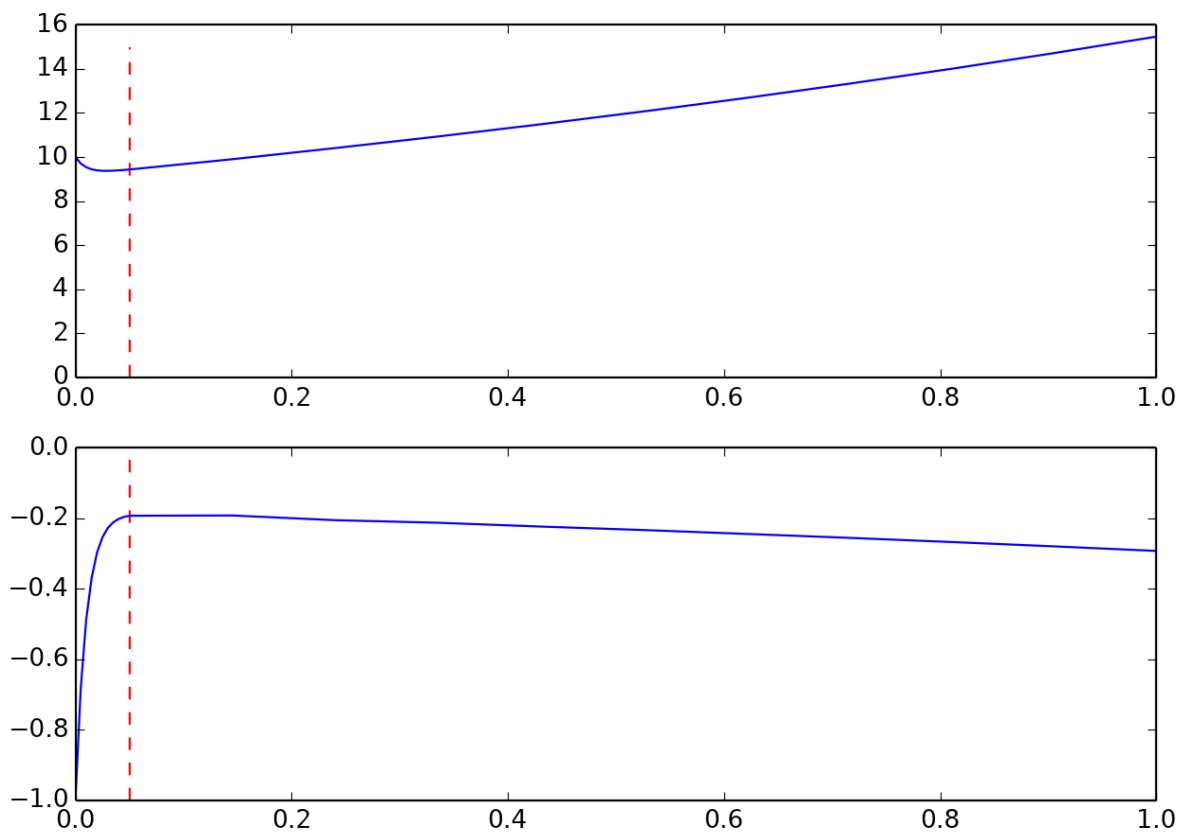
Пограничный слой:
y[ 1 ] = 10.1297023214 ; z[ 1 ] = -1.00193541362
y[ 2 ] = 10.2654965637 ; z[ 2 ] = -1.00786881929
y[ 3 ] = 10.4060809213 ; z[ 3 ] = -1.01642885657
y[ 4 ] = 10.5506422471 ; z[ 4 ] = -1.02674490965
y[ 5 ] = 10.6986782987 ; z[ 5 ] = -1.03826447955
y[ 6 ] = 10.8498848402 ; z[ 6 ] = -1.05063718816
y[ 7 ] = 11.0040839365 ; z[ 7 ] = -1.0636411044
y[ 8 ] = 11.1611784105 ; z[ 8 ] = -1.07713595155
y[ 9 ] = 11.3211229178 ; z[ 9 ] = -1.09103338844
y[ 10 ] = 11.4839055747 ; z[ 10 ] = -1.10527813492

Основная сетка:
y[ 1 ] = 11.9850021042 ; z[ 1 ] = -1.15846816696
y[ 2 ] = 12.5026766823 ; z[ 2 ] = -1.20662446159
y[ 3 ] = 13.043490255 ; z[ 3 ] = -1.25543085635
y[ 4 ] = 13.6098185808 ; z[ 4 ] = -1.30619009394
y[ 5 ] = 14.203182671 ; z[ 5 ] = -1.35924577153
y[ 6 ] = 14.8249864807 ; z[ 6 ] = -1.4147405886
y[ 7 ] = 15.4766801308 ; z[ 7 ] = -1.47278437114
y[ 8 ] = 16.1597958137 ; z[ 8 ] = -1.5334911256
y[ 9 ] = 16.8759555789 ; z[ 9 ] = -1.59698691782
y[ 10 ] = 17.6268731025 ; z[ 10 ] = -1.66341120663
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Пограничный слой:
y[ 1 ] = 9.70702795093 ; z[ 1 ] = -0.682133123235
y[ 2 ] = 9.53748756117 ; z[ 2 ] = -0.488243909507
y[ 3 ] = 9.44333188232 ; z[ 3 ] = -0.370042537071
y[ 4 ] = 9.39522867225 ; z[ 4 ] = -0.298048510069
y[ 5 ] = 9.37527090801 ; z[ 5 ] = -0.254264254143
y[ 6 ] = 9.37252658341 ; z[ 6 ] = -0.227702413856
y[ 7 ] = 9.38032188612 ; z[ 7 ] = -0.211655308669
y[ 8 ] = 9.39458259621 ; z[ 8 ] = -0.202027960687
y[ 9 ] = 9.41282152308 ; z[ 9 ] = -0.196320423275
y[ 10 ] = 9.43352034407 ; z[ 10 ] = -0.193006501914
Основная сетка:
y[ 1 ] = 9.9004964417 ; z[ 1 ] = -0.19222528895
y[ 2 ] = 10.4056177249 ; z[ 2 ] = -0.205570586663
y[ 3 ] = 10.9301085676 ; z[ 3 ] = -0.212851903998
y[ 4 ] = 11.484935393 ; z[ 4 ] = -0.223680427388
y[ 5 ] = 12.0670465077 ; z[ 5 ] = -0.233500880594
y[ 6 ] = 12.6801815119 ; z[ 6 ] = -0.24450211554
y[ 7 ] = 13.3249789956 ; z[ 7 ] = -0.255672738457
y[ 8 ] = 14.0036834589 ; z[ 8 ] = -0.267529232979
y[ 9 ] = 14.7179111775 ; z[ 9 ] = -0.279867310556
y[ 10 ] = 15.4697172321 ; z[ 10 ] = -0.292830694061
    
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Пограничный слой:
y[ 1 ] = 9.60530806183 ;   z[ 1 ] = -0.605060713274
y[ 2 ] = 9.3668667821 ;   z[ 2 ] = -0.366379808225
y[ 3 ] = 9.22285534149 ;   z[ 3 ] = -0.22213340418
y[ 4 ] = 9.13591242588 ;   z[ 4 ] = -0.134958338544
y[ 5 ] = 9.08345878467 ;   z[ 5 ] = -0.0822742442489
y[ 6 ] = 9.05184868392 ;   z[ 6 ] = -0.0504347128689
y[ 7 ] = 9.03283534623 ;   z[ 7 ] = -0.0311925594755
y[ 8 ] = 9.02143484494 ;   z[ 8 ] = -0.0195636111561
y[ 9 ] = 9.014635152 ;     z[ 9 ] = -0.0125356910476
y[ 10 ] = 9.0106159531 ;   z[ 10 ] = -0.00828839491982
Основная сетка:
y[ 1 ] = 9.46924811444 ;   z[ 1 ] = 0.00286417733432
y[ 2 ] = 9.97114013514 ;   z[ 2 ] = -0.00541788519204
y[ 3 ] = 10.4839935125 ;    z[ 3 ] = 0.000465877937165
y[ 4 ] = 11.033664031 ;    z[ 4 ] = -0.00398833974563
y[ 5 ] = 11.603691417 ;    z[ 5 ] = -0.000910809790341
y[ 6 ] = 12.2085747122 ;    z[ 6 ] = -0.00333356877958
y[ 7 ] = 12.8403420998 ;    z[ 7 ] = -0.00175304550452
y[ 8 ] = 13.5075241949 ;    z[ 8 ] = -0.00310024947324
y[ 9 ] = 14.2067409874 ;    z[ 9 ] = -0.00232103278753
y[ 10 ] = 14.9434317825 ;   z[ 10 ] = -0.00310170472742
    
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