Mateusz Łąpieś (138992)  
mateusz.lapies@student.pk.edu.pl

**Sprawozdanie**

Ćwiczenie 2 z metod obliczeniowych w nauce i technice

dla

badaniu zależności błędu metody elementów skończonych od liczby stopni swobody dla różnych rozwiązań i sposobów zagęszczania siatki

**Zadanie 1**

**Parametry:**

* A
  + 35
  + 0.51
* B
  + 0.6
  + 0.8
* C
  + 47
  + -1.87
  + 1.97

**Wyniki:**

**Zadanie 2**

**Parametry:**

* df/dx=power(x,2)\*(3\*acos(x-1)-(x/sqrt(-1\*(x-2)\*x)))

**Wyniki:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| |x-xn| | |x-xn| | |x-xn| |  | LOG10(|x-xn|) | LOG10(|x-xn|) | LOG10(|x-xn|) |
| bisect | newton | siecz | n | bisect | siecz | newton |
| 0,25 | 0,517505751 | 0,281971863 | 1 | -0,602059991 | -0,549794226 | -0,286084819 |
| 0,125 | 0,168742269 | 4,39E-02 | 2 | -0,903089987 | -1,357762146 | -0,772776116 |
| 0,0625 | 1,72E-02 | 4,94E-03 | 3 | -1,204119983 | -2,306522657 | -1,76531665 |
| 0,03125 | 2,20E-04 | 5,28E-04 | 4 | -1,505149978 | -3,277510023 | -3,657245742 |
| 0,015625 | 3,66E-08 | 5,61E-05 | 5 | -1,806179974 | -4,251012017 | -7,436030615 |
| 0,0078125 | 9,99E-16 | 5,96E-06 | 6 | -2,10720997 | -5,224783032 | -15,00034726 |
| 0,00390625 |  | 6,33E-07 | 7 | -2,408239965 | -6,198582643 |  |
| 0,001953125 |  | 6,72E-08 | 8 | -2,709269961 | -7,172385291 |  |
| 0,000976563 |  | 7,14E-09 | 9 | -3,010299957 | -8,146188263 |  |
| 0,000488281 |  | 7,59E-10 | 10 | -3,311329952 | -9,119991316 |  |
| 0,000244141 |  | 8,06E-11 | 11 | -3,612359948 | -10,09379435 |  |
| 0,00012207 |  | 8,56E-12 | 12 | -3,913389944 | -11,06759736 |  |
| 6,10352E-05 |  | 9,09E-13 | 13 | -4,214419939 | -12,04141194 |  |
| 3,05176E-05 |  | 9,66E-14 | 14 | -4,515449935 | -13,01507052 |  |
| 1,52588E-05 |  | 1,03E-14 | 15 | -4,816479931 | -13,98610682 |  |
| 7,62939E-06 |  | 1,11E-15 | 16 | -5,117509926 | -14,95458977 |  |
| 3,8147E-06 |  |  | 17 | -5,418539922 |  |  |
| 1,90735E-06 |  |  | 18 | -5,719569918 |  |  |
| 9,53674E-07 |  |  | 19 | -6,020599913 |  |  |
| 4,76837E-07 |  |  | 20 | -6,321629909 |  |  |
| 2,38419E-07 |  |  | 21 | -6,622659905 |  |  |
| 1,19209E-07 |  |  | 22 | -6,9236899 |  |  |
| 5,96046E-08 |  |  | 23 | -7,224719896 |  |  |
| 2,98023E-08 |  |  | 24 | -7,525749892 |  |  |
| 1,49012E-08 |  |  | 25 | -7,826779887 |  |  |
| 7,45058E-09 |  |  | 26 | -8,127809883 |  |  |
| 3,72529E-09 |  |  | 27 | -8,428839879 |  |  |
| 1,86265E-09 |  |  | 28 | -8,729869874 |  |  |
| 9,31323E-10 |  |  | 29 | -9,03089987 |  |  |
| 4,65661E-10 |  |  | 30 | -9,331929866 |  |  |
| 2,32831E-10 |  |  | 31 | -9,632959861 |  |  |
| 1,16415E-10 |  |  | 32 | -9,933989857 |  |  |
| 5,82077E-11 |  |  | 33 | -10,23501985 |  |  |
| 2,91038E-11 |  |  | 34 | -10,53604985 |  |  |
| 1,45519E-11 |  |  | 35 | -10,83707984 |  |  |
| 7,27596E-12 |  |  | 36 | -11,13810984 |  |  |
| 3,63798E-12 |  |  | 37 | -11,43913984 |  |  |
| 1,81899E-12 |  |  | 38 | -11,74016983 |  |  |
| 9,09495E-13 |  |  | 39 | -12,04119983 |  |  |
| 4,54747E-13 |  |  | 40 | -12,34222982 |  |  |
| 2,27374E-13 |  |  | 41 | -12,64325982 |  |  |
| 1,13687E-13 |  |  | 42 | -12,94428981 |  |  |
| 5,68434E-14 |  |  | 43 | -13,24531981 |  |  |
| 2,84217E-14 |  |  | 44 | -13,5463498 |  |  |
| 1,42109E-14 |  |  | 45 | -13,8473798 |  |  |
| 7,10543E-15 |  |  | 46 | -14,1484098 |  |  |

**Zadanie 3**

**Parametry:**

* A=[-2 3 0 1 ; 3 -8 2 0 ; 0 2 5 -1 ; 1 0 -1 -4]

**Wyniki:**

eig(A)=

-9.4906

-4.3861

-0.5450

5.4217

**Wektory**

B = [-9.4906 0 0 0]

C = [0 -9.4906 0 0]

D = [0 0 -0.5450 0]

E = [0 0 0 5.4217]

**Prostopadłość wektorów**

dot(B, C) = 0

dot(C, D) = 0

dot(D, E) = 0

dot(B, D) = 0

dot(B, E) = 0

dot(C, E) = 0

**Sprawdzenia**

det(A) = -123

**Zadanie 4**

**Parametry:**

* B=[2 ; 3 ; -5 ; 0]

**Wyniki:**

|  |  |  |
| --- | --- | --- |
| błąd | i | LOG10(błąd) |
| 1,00E+07 | 1 | 7 |
| 1,00E+00 | 2 | 0 |
| 6,25E-01 | 3 | -0,204119983 |
| 9,38E-01 | 4 | -0,028028724 |
| 3,49E-01 | 5 | -0,456902447 |
| 5,82E-01 | 6 | -0,235053697 |
| 2,32E-01 | 7 | -0,635166963 |
| 3,86E-01 | 8 | -0,413318214 |
| 1,52E-01 | 9 | -0,818743106 |
| 2,53E-01 | 10 | -0,596894357 |
| 9,97E-02 | 11 | -1,001359767 |
| 1,66E-01 | 12 | -0,779511018 |
| 6,54E-02 | 13 | -1,184150459 |
| 1,09E-01 | 14 | -0,96230171 |
| 4,30E-02 | 15 | -1,366909609 |
| 7,16E-02 | 16 | -1,145060859 |
| 2,82E-02 | 17 | -1,549674477 |
| 4,70E-02 | 18 | -1,327825727 |
| 1,85E-02 | 19 | -1,732438307 |
| 3,09E-02 | 20 | -1,510589558 |
| 1,22E-02 | 21 | -1,915202326 |
| 2,03E-02 | 22 | -1,693353577 |
| 7,98E-03 | 23 | -2,097966311 |
| 1,33E-02 | 24 | -1,876117562 |
| 5,24E-03 | 25 | -2,280730302 |
| 8,73E-03 | 26 | -2,058881553 |
| 3,44E-03 | 27 | -2,463494292 |
| 5,73E-03 | 28 | -2,241645542 |
| 2,26E-03 | 29 | -2,646258282 |
| 3,76E-03 | 30 | -2,424409532 |
| 1,48E-03 | 31 | -2,829022272 |
| 2,47E-03 | 32 | -2,607173522 |
| 9,73E-04 | 33 | -3,011786262 |
| 1,62E-03 | 34 | -2,789937512 |
| 6,39E-04 | 35 | -3,194550252 |
| 1,06E-03 | 36 | -2,972701502 |
| 4,19E-04 | 37 | -3,377314242 |
| 6,99E-04 | 38 | -3,155465493 |
| 2,75E-04 | 39 | -3,560078232 |
| 4,59E-04 | 40 | -3,338229483 |
| 1,81E-04 | 41 | -3,742842222 |
| 3,01E-04 | 42 | -3,520993473 |
| 1,19E-04 | 43 | -3,925606212 |
| 1,98E-04 | 44 | -3,703757463 |
| 7,79E-05 | 45 | -4,108370202 |
| 1,30E-04 | 46 | -3,886521453 |
| 5,12E-05 | 47 | -4,291134192 |
| 8,53E-05 | 48 | -4,069285443 |
| 3,36E-05 | 49 | -4,473898182 |
| 5,60E-05 | 50 | -4,252049433 |
| 2,20E-05 | 51 | -4,656662172 |
| 3,67E-05 | 52 | -4,434813423 |
| 1,45E-05 | 53 | -4,839426162 |
| 2,41E-05 | 54 | -4,617577413 |
| 9,50E-06 | 55 | -5,022190152 |
| 1,58E-05 | 56 | -4,800341403 |
| 6,24E-06 | 57 | -5,204954142 |
| 1,04E-05 | 58 | -4,983105393 |
| 4,10E-06 | 59 | -5,387718132 |
| 6,83E-06 | 60 | -5,165869383 |
| 2,69E-06 | 61 | -5,570482123 |
| 4,48E-06 | 62 | -5,348633373 |
| 1,77E-06 | 63 | -5,753246113 |
| 2,94E-06 | 64 | -5,531397363 |
| 1,16E-06 | 65 | -5,936010103 |
| 1,93E-06 | 66 | -5,714161353 |
| 7,61E-07 | 67 | -6,118774093 |
| 1,27E-06 | 68 | -5,896925343 |
| 4,99E-07 | 69 | -6,301538082 |
| 8,32E-07 | 70 | -6,079689333 |
| 3,28E-07 | 71 | -6,484302072 |
| 5,46E-07 | 72 | -6,262453323 |
| 2,15E-07 | 73 | -6,667066063 |
| 3,59E-07 | 74 | -6,445217312 |
| 1,41E-07 | 75 | -6,849830054 |
| 2,36E-07 | 76 | -6,627981302 |