3Министерство образования и науки Российской Федерации

НОВОСИБИРСКИЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

Кафедра прикладной математики

Лабораторная работа №2

по дисциплине «Численные методы»

Группа ПМ-63

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1. Цель работы

Разработать программы решения СЛАУ методами Якоби, Гаусса-Зейделя, блочной релаксации с хранением матрицы в диагональном формате. Исследовать сходимость методов для различных тестовых матриц и её зависимость от параметра релаксации. Изучить возможность оценки порядка числа обусловленности матрицы путем вычислительного эксперимента.

1. Анализ

Произведём реализацию метода Якоби, основываясь на следующей формуле:



Произведём реализацию метода Гаусса-Зейделя, основываясь на следующей формуле:



Для всех методов итерации будут прекращаться по достижении их заданного количества, либо по относительной невязке.

1. Тест

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3 | 0 | 1 |  | 1 |  | 10 |
| 1 | 7 | 0 | \* | 2 | = | 15 |
| 0 | 3 | 8 |  | 3 |  | 25 |

e = 1e-10

|  |  |
| --- | --- |
| Метод Якоби | Метод Гаусса-Зейделя |
| w = 1 k = 17  1.000000000453942 | -4.539415510151912e-10 2.000000000259395 | -2.593951720086807e-10 3.000000000097273 | -9.727330052555772e-11 | w = 1 k = 7  1.000000000032425 | -3.242450752338755e-11  1.999999999995368 | 4.632072503341078e-12  3.000000000001737 | -1.737276988933445e-12 |

1. Матрица с диагональным преобладанием

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ax = F | 8 | -1 |  |  |  |  | -3 | -1 | -2 |  |  |  |  | 1 |  | -41 |
| -2 | 11 | -3 |  |  |  |  | -2 | -1 | -3 |  |  |  | 2 |  | -44 |
|  | -1 | 9 | -2 |  |  |  |  | -2 | -1 | -3 |  |  | 3 |  | -44 |
|  |  | -3 | 10 | -1 |  |  |  |  | -1 | -3 | -2 |  | 4 |  | -41 |
|  |  |  | -2 | 8 | -1 |  |  |  |  | -2 | -3 |  | 5 |  | -32 |
|  |  |  |  | -2 | 6 | -2 |  |  |  |  | -2 |  | 6 |  | -12 |
| -3 |  |  |  |  | -2 | 8 | -3 |  |  |  |  | \* | 7 | = | 17 |
| -2 | -3 |  |  |  |  | -1 | 8 | -2 |  |  |  |  | 8 |  | 31 |
| -1 | -3 | -2 |  |  |  |  | -3 | 10 | -1 |  |  |  | 9 |  | 43 |
|  | -2 | -1 | -3 |  |  |  |  | -2 | 9 | -1 |  |  | 10 |  | 42 |
|  |  | -2 | -1 | -3 |  |  |  |  | -2 | 11 | -3 |  | 11 |  | 40 |
|  |  |  | -3 | -1 | -2 |  |  |  |  | -1 | 7 |  | 12 |  | 44 |

e = 1e-14

|  |  |
| --- | --- |
| Метод Якоби | Метод Гаусса-Зейделя |
| Coud A = 78.8099 w = 0.1 k = 37973  0.999999999995142 | 4.858446978062148e-12 1.999999999994328 | 5.672351477414850e-12 2.999999999994038 | 5.962341731446941e-12 3.999999999993932 | 6.068479052601106e-12 4.999999999993912 | 6.088463067044358e-12 5.999999999994114 | 5.885958387352730e-12 6.999999999994620 | 5.379696688123659e-12 7.999999999994536 | 5.464073637995170e-12 8.999999999994351 | 5.648814749292796e-12 9.999999999994083 | 5.917044632042234e-12 10.999999999993930 | 6.069811320230656e-12 11.999999999993937 | 6.062705892873055e-12 | Coud A = 78.43 w = 0.1 k = 36066 0.999999999995147 | 4.852895862939022e-12 1.999999999994338 | 5.661915380983373e-12 2.999999999994056 | 5.944134073843088e-12 3.999999999993952 | 6.048050948948003e-12 4.999999999993931 | 6.068923141810956e-12 5.999999999994128 | 5.871747532637528e-12 6.999999999994629 | 5.370814903926657e-12 7.999999999994543 | 5.456968210637569e-12 8.999999999994362 | 5.638156608256395e-12 9.999999999994101 | 5.899281063648232e-12 10.999999999993953 | 6.046718681318453e-12 11.999999999993959 | 6.041389610800252e-12 |
| Coud A = 78.5489 w = 0.2 k = 18982 0.999999999995135 | 4.864886271604973e-12 1.999999999994320 | 5.679900993982301e-12 2.999999999994031 | 5.968558980384842e-12 3.999999999993924 | 6.076028569168557e-12 4.999999999993902 | 6.098233029661060e-12 5.999999999994104 | 5.895728349969431e-12 6.999999999994612 | 5.387690293900960e-12 7.999999999994528 | 5.472067243772472e-12 8.999999999994341 | 5.659472890329198e-12 9.999999999994072 | 5.927702773078636e-12 10.999999999993920 | 6.080469461267057e-12 11.999999999993925 | 6.075140390748857e-12 | Coud A = 78.244 w = 0.2 k = 17078 0.999999999995163 | 4.837241718291807e-12 1.999999999994356 | 5.643929767984446e-12 2.999999999994074 | 5.926370505449086e-12 3.999999999993971 | 6.029399202134300e-12 4.999999999993950 | 6.050271394997253e-12 5.999999999994147 | 5.853095785823825e-12 6.999999999994646 | 5.353939513952355e-12 7.999999999994563 | 5.437428285404167e-12 8.999999999994381 | 5.618616683022992e-12 9.999999999994120 | 5.879741138414829e-12 10.999999999993973 | 6.027178756085050e-12 11.999999999993978 | 6.021849685566849e-12 |
| Coud A = 78.5989 w = 0.3 k = 12679 0.999999999995148 | 4.852118706821784e-12 1.999999999994337 | 5.662581514798148e-12 2.999999999994051 | 5.948574965941589e-12 3.999999999993944 | 6.055600465515454e-12 4.999999999993923 | 6.076916747588257e-12 5.999999999994122 | 5.877964781575429e-12 6.999999999994624 | 5.376143974444858e-12 7.999999999994540 | 5.459632745896670e-12 8.999999999994355 | 5.645262035613996e-12 9.999999999994090 | 5.909939204684633e-12 10.999999999993941 | 6.059153179194254e-12 11.999999999993946 | 6.053824108676054e-12 | Coud A = 77.73788 w = 0.3 k = 10771 0.999999999995192 | 4.808375919651553e-12 1.999999999994390 | 5.610178988035841e-12 2.999999999994110 | 5.890399279451231e-12 3.999999999994007 | 5.993427976136445e-12 4.999999999993985 | 6.014744258209248e-12 5.999999999994182 | 5.817568649035820e-12 6.999999999994679 | 5.321076912423450e-12 7.999999999994596 | 5.403677505455562e-12 8.999999999994417 | 5.583089546234987e-12 9.999999999994156 | 5.844214001626824e-12 10.999999999994007 | 5.993427976136445e-12 11.999999999994017 | 5.982769835100044e-12 |
| Coud A = 78.0550 w = 0.4 k = 9499 0.999999999995178 | 4.821698595947055e-12 1.999999999994373 | 5.627498467219993e-12 2.999999999994088 | 5.911715561524034e-12 3.999999999993982 | 6.018296971888049e-12 4.999999999993959 | 6.041389610800252e-12 5.999999999994158 | 5.842437644787424e-12 6.999999999994658 | 5.342393194496253e-12 7.999999999994575 | 5.424993787528365e-12 8.999999999994392 | 5.607958541986591e-12 9.999999999994129 | 5.870859354217828e-12 10.999999999993978 | 6.021849685566849e-12 11.999999999993985 | 6.014744258209248e-12 | Coud A = 77.9008 w = 0.4 k = 7589 0.999999999995194 | 4.806155473602303e-12 1.999999999994395 | 5.605294006727490e-12 2.999999999994116 | 5.884182030513330e-12 3.999999999994015 | 5.985434370359144e-12 4.999999999993994 | 6.005862474012247e-12 5.999999999994190 | 5.810463221678219e-12 6.999999999994683 | 5.316636020324950e-12 7.999999999994603 | 5.396572078097961e-12 8.999999999994426 | 5.574207762037986e-12 9.999999999994168 | 5.831779503751022e-12 10.999999999994021 | 5.979217121421243e-12 11.999999999994028 | 5.972111694063642e-12 |
| Coud A = 78.5 w = 0.5 k = 7594 0.999999999995137 | 4.862776847858186e-12 1.999999999994325 | 5.675460101883800e-12 2.999999999994039 | 5.961453553027241e-12 3.999999999993931 | 6.068923141810956e-12 4.999999999993909 | 6.091127602303459e-12 5.999999999994109 | 5.891287457870931e-12 6.999999999994612 | 5.387690293900960e-12 7.999999999994529 | 5.471179065352771e-12 8.999999999994344 | 5.655920176650397e-12 9.999999999994078 | 5.922373702560435e-12 10.999999999993928 | 6.071587677070056e-12 11.999999999993934 | 6.066258606551855e-12 | Coud A = 76.536 w = 0.5 k = 5688 0.999999999995257 | 4.742872761198669e-12 1.999999999994469 | 5.530687019472680e-12 2.999999999994194 | 5.805578240369869e-12 3.999999999994096 | 5.904166044956582e-12 4.999999999994076 | 5.924150059399835e-12 5.999999999994270 | 5.729638985485508e-12 6.999999999994758 | 5.242029033070139e-12 7.999999999994678 | 5.321965090843150e-12 8.999999999994504 | 5.496048061104375e-12 9.999999999994252 | 5.748290732299211e-12 10.999999999994102 | 5.897504706808832e-12 11.999999999994115 | 5.885070208933030e-12 |
| Coud A = 78.8848 w = 0.6 k = 6326 0.999999999995139 | 4.861444580228635e-12 1.999999999994327 | 5.672795566624700e-12 2.999999999994041 | 5.958789017768140e-12 3.999999999993934 | 6.065814517342005e-12 4.999999999993912 | 6.087574888624658e-12 5.999999999994111 | 5.888622922611830e-12 6.999999999994614 | 5.385913937061559e-12 7.999999999994531 | 5.468514530093671e-12 8.999999999994348 | 5.652367462971597e-12 9.999999999994081 | 5.918820988881635e-12 10.999999999993930 | 6.069811320230656e-12 11.999999999993937 | 6.062705892873055e-12 | Coud A = 74.7433 w = 0.6 k = 4423 0.999999999995398 | 4.602207503978661e-12 1.999999999994634 | 5.365929922618307e-12 2.999999999994369 | 5.630607091688944e-12 3.999999999994276 | 5.723865825757457e-12 4.999999999994257 | 5.742961661781010e-12 5.999999999994444 | 5.556444193643983e-12 6.999999999994916 | 5.083933274363517e-12 7.999999999994840 | 5.160316618457728e-12 8.999999999994671 | 5.329070518200751e-12 9.999999999994428 | 5.572431405198586e-12 10.999999999994289 | 5.710987238671805e-12 11.999999999994298 | 5.702105454474804e-12 |
| Coud A = 78.9675 w = 0.7 k = 5420 0.999999999995133 | 4.867217739956686e-12 1.999999999994320 | 5.679900993982301e-12 2.999999999994034 | 5.965894445125741e-12 3.999999999993927 | 6.072919944699606e-12 4.999999999993905 | 6.094680315982259e-12 5.999999999994104 | 5.895728349969431e-12 6.999999999994608 | 5.392131185999460e-12 7.999999999994523 | 5.476508135870972e-12 8.999999999994341 | 5.659472890329198e-12 9.999999999994074 | 5.925926416239236e-12 10.999999999993925 | 6.075140390748857e-12 11.999999999993930 | 6.069811320230656e-12 | Coud A = 73.0233 w = 0.7 k = 3516 0.999999999995455 | 4.544697951303078e-12 1.999999999994703 | 5.296874050486622e-12 2.999999999994443 | 5.557332372063684e-12 3.999999999994353 | 5.647482481663246e-12 4.999999999994335 | 5.664801960847399e-12 5.999999999994521 | 5.479172671130073e-12 6.999999999994984 | 5.015543536046607e-12 7.999999999994910 | 5.090150523301418e-12 8.999999999994746 | 5.254463530945941e-12 9.999999999994506 | 5.494271704264975e-12 10.999999999994367 | 5.632827537738194e-12 11.999999999994381 | 5.618616683022992e-12 |
| Coud A = 78.609 w = 0.8 k = 4742 0.999999999995160 | 4.840350342760757e-12 1.999999999994350 | 5.649702927712497e-12 2.999999999994064 | 5.936140468065787e-12 3.999999999993957 | 6.042721878429802e-12 4.999999999993936 | 6.064482249712455e-12 5.999999999994135 | 5.864642105279927e-12 6.999999999994638 | 5.361933119729656e-12 7.999999999994555 | 5.445421891181468e-12 8.999999999994369 | 5.631051180898794e-12 9.999999999994104 | 5.895728349969431e-12 10.999999999993953 | 6.046718681318453e-12 11.999999999993960 | 6.039613253960852e-12 | Coud A = 71.2586 w = 0.8 k = 2837 0.999999999995579 | 4.420797061754911e-12 1.999999999994848 | 5.151878923470576e-12 2.999999999994597 | 5.402789327035862e-12 3.999999999994512 | 5.488054455327074e-12 4.999999999994495 | 5.504929845301376e-12 5.999999999994674 | 5.326405982941651e-12 6.999999999995125 | 4.875211345733987e-12 7.999999999995053 | 4.947153797729698e-12 8.999999999994895 | 5.105249556436320e-12 9.999999999994664 | 5.336175945558352e-12 10.999999999994531 | 5.469402708513371e-12 11.999999999994545 | 5.455191853798169e-12 |
| Coud A = 78.337 w = 0.9 k = 4214 0.999999999995183 | 4.816924636941167e-12 1.999999999994378 | 5.621947352096868e-12 2.999999999994095 | 5.904610134166433e-12 3.999999999993988 | 6.011635633740298e-12 4.999999999993967 | 6.032507826603251e-12 5.999999999994164 | 5.836220395849523e-12 6.999999999994663 | 5.337064123978053e-12 7.999999999994581 | 5.418776538590464e-12 8.999999999994397 | 5.602629471468390e-12 9.999999999994134 | 5.865530283699627e-12 10.999999999993983 | 6.016520615048648e-12 11.999999999993991 | 6.009415187691047e-12 | Coud A = 68.336 w = 0.9 k = 2309 0.999999999995768 | 4.232281192173559e-12 1.999999999995071 | 4.928946140125845e-12 2.999999999994833 | 5.166533867395628e-12 3.999999999994754 | 5.245581746748940e-12 4.999999999994739 | 5.260680779883842e-12 5.999999999994909 | 5.091038701721118e-12 6.999999999995338 | 4.662048525005957e-12 7.999999999995270 | 4.729550084903167e-12 8.999999999995124 | 4.876099524153688e-12 9.999999999994905 | 5.094591415399918e-12 10.999999999994779 | 5.220712750997336e-12 11.999999999994792 | 5.208278253121534e-12 |
| Coud A = 78.633 w = 1 k = 3790 0.999999999995136 | 4.863665026277886e-12 1.999999999994324 | 5.676126235698575e-12 2.999999999994037 | 5.962785820656791e-12 3.999999999993931 | 6.068923141810956e-12 4.999999999993909 | 6.091127602303459e-12 5.999999999994109 | 5.891287457870931e-12 6.999999999994612 | 5.387690293900960e-12 7.999999999994528 | 5.472067243772472e-12 8.999999999994344 | 5.655920176650397e-12 9.999999999994078 | 5.922373702560435e-12 10.999999999993928 | 6.071587677070056e-12 11.999999999993934 | 6.066258606551855e-12 | Coud A = 64.59298 w = 1 k = 1886 0.999999999995967 | 4.033218203858269e-12 1.999999999995304 | 4.696243394164412e-12 2.999999999995079 | 4.921396623558394e-12 3.999999999995007 | 4.992894986344254e-12 4.999999999994992 | 5.007549930269306e-12 5.999999999995155 | 4.845013279464183e-12 6.999999999995561 | 4.439115741661226e-12 7.999999999995498 | 4.502176409459935e-12 8.999999999995362 | 4.638067707674054e-12 9.999999999995154 | 4.845901457883883e-12 10.999999999995035 | 4.964917366123700e-12 11.999999999995051 | 4.948930154569098e-12 |

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| Максимальное значение параметра релаксации | |
| Метод Якобе |  |
| Coud A = 0.4334 w = 1.27 k = 4726 0.999999999999964 | 3.597122599785507e-14 2.000000000000001 | -8.881784197001252e-16 3.000000000000024 | -2.398081733190338e-14 3.999999999999989 | 1.110223024625157e-14 5.000000000000003 | -2.664535259100376e-15 5.999999999999940 | 5.950795411990839e-14 7.000000000000054 | -5.417888360170764e-14 8.000000000000007 | -7.105427357601002e-15 8.999999999999996 | 3.552713678800501e-15 10.000000000000014 | -1.421085471520200e-14 10.999999999999975 | 2.486899575160351e-14 12.000000000000053 | -5.329070518200751e-14 | Coud A = 0.568 w = 1.88 k = 3743 0.999999999999927 | 7.349676423018536e-14 2.000000000000027 | -2.664535259100376e-14 3.000000000000007 | -6.661338147750939e-15 4.000000000000016 | -1.598721155460225e-14 4.999999999999981 | 1.865174681370263e-14 6.000000000000071 | -7.105427357601002e-14 7.000000000000020 | -1.953992523340276e-14 7.999999999999920 | 7.993605777301127e-14 8.999999999999996 | 3.552713678800501e-15 10.000000000000014 | -1.421085471520200e-14 10.999999999999970 | 3.019806626980426e-14 12.000000000000034 | -3.375077994860476e-14 |
| w = 1.280000000000000 k = 1000001  -nan(ind) | -nan(ind)  … | w = 1.890000000000000 k = 10000001  -nan(ind) | -nan(ind)  … |
| Метод Блочной релаксации b = 2 | Метод Блочной релаксации b = 2 |
| Coud A = 0.522 w = 1.87 k = 5187 0.999999999999983 | 1.698641227676490e-14 1.999999999999992 | 8.437694987151190e-15 3.000000000000003 | -2.664535259100376e-15 3.999999999999982 | 1.776356839400250e-14 5.000000000000052 | -5.240252676230739e-14 5.999999999999995 | 5.329070518200751e-15 7.000000000000012 | -1.243449787580175e-14 8.000000000000041 | -4.085620730620576e-14 8.999999999999991 | 8.881784197001252e-15 9.999999999999915 | 8.526512829121202e-14 11.000000000000043 | -4.263256414560601e-14 11.999999999999956 | 4.440892098500626e-14 | Coud A = 0.523 w = 1.9 k = 3453 0.999999999999963 | 3.652633751016765e-14 1.999999999999981 | 1.865174681370263e-14 3.000000000000016 | -1.598721155460225e-14 3.999999999999951 | 4.929390229335695e-14 4.999999999999996 | 3.552713678800501e-15 6.000000000000024 | -2.398081733190338e-14 7.000000000000034 | -3.375077994860476e-14 8.000000000000018 | -1.776356839400250e-14 8.999999999999941 | 5.861977570020827e-14 9.999999999999950 | 4.973799150320701e-14 11.000000000000037 | -3.730349362740526e-14 11.999999999999936 | 6.394884621840902e-14 |
| w = 1.880000000000000 k = 20001  …. | -3.348552394367934e+45 | w = 1.910000000000000 k = 20001  ….| 6.002751118382662e+16 |

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| Определение оптимального веса. | |
| Метод Якоби | Метод Гаусса-Зейделя |
| Coud A = 78.652 w = 1.25 k = 3030 0.999999999995170 | 4.830025268631744e-12 1.999999999994366 | 5.633715716157894e-12 2.999999999994079 | 5.921041434930885e-12 3.999999999993974 | 6.025846488455500e-12 4.999999999993952 | 6.048495038157853e-12 5.999999999994150 | 5.849543072145025e-12 6.999999999994651 | 5.348610443434154e-12 7.999999999994565 | 5.434763750145066e-12 8.999999999994385 | 5.615063969344192e-12 9.999999999994118 | 5.881517495254229e-12 10.999999999993971 | 6.028955112924450e-12 11.999999999993975 | 6.025402399245650e-12 | Coud A = 10.6875 w = 1.75 k = 196 0.999999999999332 | 6.679101716144942e-13 1.999999999999234 | 7.658318423864330e-13 2.999999999999216 | 7.842615445952106e-13 3.999999999999226 | 7.736034035588091e-13 4.999999999999234 | 7.656097977815080e-13 5.999999999999253 | 7.469580509678053e-13 6.999999999999305 | 6.945555242054979e-13 7.999999999999314 | 6.856737400084967e-13 8.999999999999311 | 6.892264536872972e-13 9.999999999999286 | 7.140954494389007e-13 10.999999999999284 | 7.158718062783009e-13 11.999999999999286 | 7.140954494389007e-13 |
| Coud A = 78.4431 w = 1.26 k = 3005 0.999999999995136 | 4.863998093185273e-12 1.999999999994324 | 5.676348280303500e-12 2.999999999994035 | 5.964562177496191e-12 3.999999999993931 | 6.068923141810956e-12 4.999999999993909 | 6.091127602303459e-12 5.999999999994111 | 5.888622922611830e-12 6.999999999994609 | 5.391243007579760e-12 7.999999999994526 | 5.473843600611872e-12 8.999999999994342 | 5.657696533489798e-12 9.999999999994074 | 5.925926416239236e-12 10.999999999993928 | 6.071587677070056e-12 11.999999999993930 | 6.069811320230656e-12 | Coud A = 0.5925 w = 1.76 k = 197 0.999999999999935 | 6.517009154549669e-14 1.999999999999992 | 7.549516567451064e-15 3.000000000000000 | -4.440892098500626e-16 4.000000000000018 | -1.776356839400250e-14 4.999999999999970 | 3.019806626980426e-14 5.999999999999965 | 3.463895836830488e-14 7.000000000000020 | -1.953992523340276e-14 7.999999999999925 | 7.460698725481052e-14 8.999999999999934 | 6.572520305780927e-14 10.000000000000030 | -3.019806626980426e-14 10.999999999999959 | 4.085620730620576e-14 12.000000000000014 | -1.421085471520200e-14 |
| Coud A = 0.433 w = 1.27 k = 4726 0.999999999999964 | 3.597122599785507e-14 2.000000000000001 | -8.881784197001252e-16 3.000000000000024 | -2.398081733190338e-14 3.999999999999989 | 1.110223024625157e-14 5.000000000000003 | -2.664535259100376e-15 5.999999999999940 | 5.950795411990839e-14 7.000000000000054 | -5.417888360170764e-14 8.000000000000007 | -7.105427357601002e-15 8.999999999999996 | 3.552713678800501e-15 10.000000000000014 | -1.421085471520200e-14 10.999999999999975 | 2.486899575160351e-14 12.000000000000053 | -5.329070518200751e-14 | Coud A = 0.518 w = 1.77 k = 214 0.999999999999940 | 5.950795411990839e-14 2.000000000000024 | -2.353672812205332e-14 2.999999999999990 | 1.021405182655144e-14 4.000000000000003 | -2.664535259100376e-15 4.999999999999969 | 3.108624468950438e-14 6.000000000000044 | -4.440892098500626e-14 7.000000000000022 | -2.220446049250313e-14 7.999999999999929 | 7.105427357601002e-14 9.000000000000004 | -3.552713678800501e-15 10.000000000000023 | -2.309263891220326e-14 10.999999999999957 | 4.263256414560601e-14 12.000000000000012 | -1.243449787580175e-14 |

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| Определение оптимального веса, для блочной релаксации | |
| B = 2 | B = 3 |
| Coud A = 8.99 w = 1.72 k = 183 0.999999999999442 | 5.575540029667536e-13 1.999999999999337 | 6.628031457012185e-13 2.999999999999344 | 6.559197629485425e-13 3.999999999999330 | 6.701306176637445e-13 4.999999999999342 | 6.581402089977928e-13 5.999999999999346 | 6.536993168992922e-13 6.999999999999432 | 5.675460101883800e-13 7.999999999999410 | 5.897504706808832e-13 8.999999999999419 | 5.808686864838819e-13 9.999999999999389 | 6.110667527536862e-13 10.999999999999400 | 6.004086117172847e-13 11.999999999999389 | 6.110667527536862e-13 | Coud A = 8.95 w = 1.7 k = 166 0.999999999999483 | 5.172529071728604e-13 1.999999999999400 | 5.995204332975845e-13 2.999999999999365 | 6.354916592954396e-13 3.999999999999385 | 6.150635556423367e-13 4.999999999999374 | 6.261657858885883e-13 5.999999999999385 | 6.146194664324867e-13 6.999999999999482 | 5.178080186851730e-13 7.999999999999473 | 5.266898028821743e-13 8.999999999999449 | 5.506706202140776e-13 9.999999999999449 | 5.506706202140776e-13 10.999999999999432 | 5.684341886080801e-13 11.999999999999433 | 5.666578317686799e-13 |
| Coud A = 1.04 w = 1.73 k = 177 0.999999999999925 | 7.460698725481052e-14 1.999999999999986 | 1.443289932012704e-14 2.999999999999920 | 7.993605777301127e-14 3.999999999999936 | 6.439293542825908e-14 4.999999999999914 | 8.615330671091215e-14 5.999999999999978 | 2.220446049250313e-14 6.999999999999917 | 8.348877145181177e-14 7.999999999999919 | 8.082423619271140e-14 8.999999999999995 | 5.329070518200751e-15 9.999999999999975 | 2.486899575160351e-14 10.999999999999918 | 8.171241461241152e-14 11.999999999999977 | 2.309263891220326e-14 | Coud A = 0.6 w = 1.71 k = 161 0.999999999999934 | 6.639133687258436e-14 2.000000000000009 | -9.325873406851315e-15 2.999999999999988 | 1.154631945610163e-14 3.999999999999954 | 4.574118861455645e-14 4.999999999999972 | 2.753353101070388e-14 6.000000000000059 | -5.861977570020827e-14 6.999999999999957 | 4.263256414560601e-14 7.999999999999980 | 1.953992523340276e-14 9.000000000000036 | -3.552713678800501e-14 9.999999999999986 | 1.421085471520200e-14 10.999999999999975 | 2.486899575160351e-14 12.000000000000011 | -1.065814103640150e-14 |
| Coud A = 0.54 w = 1.74 k = 190 0.999999999999991 | 9.103828801926284e-15 2.000000000000030 | -2.975397705995420e-14 2.999999999999978 | 2.176037128265307e-14 4.000000000000004 | -4.440892098500626e-15 4.999999999999953 | 4.707345624410664e-14 6.000000000000021 | -2.131628207280301e-14 6.999999999999973 | 2.664535259100376e-14 7.999999999999960 | 3.996802888650564e-14 9.000000000000030 | -3.019806626980426e-14 10.000000000000060 | -6.039613253960852e-14 10.999999999999959 | 4.085620730620576e-14 12.000000000000037 | -3.730349362740526e-14 | Coud A = 0.55 w = 1.72 k = 173 1.000000000000071 | -7.083222897108499e-14 1.999999999999972 | 2.775557561562891e-14 3.000000000000024 | -2.442490654175344e-14 4.000000000000060 | -5.950795411990839e-14 4.999999999999991 | 8.881784197001252e-15 5.999999999999932 | 6.838973831690964e-14 7.000000000000032 | -3.197442310920451e-14 7.999999999999988 | 1.154631945610163e-14 8.999999999999964 | 3.552713678800501e-14 10.000000000000048 | -4.796163466380676e-14 10.999999999999993 | 7.105427357601002e-15 12.000000000000014 | -1.421085471520200e-14 |

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| Определение оптимального веса, для блочной релаксации | |
| B = 4 | B = 6 |
| Coud A = 8.13 w = 1.71 k = 142 0.999999999999561 | 4.386491170293993e-13 1.999999999999500 | 5.000444502911705e-13 2.999999999999479 | 5.209166431541234e-13 3.999999999999467 | 5.329070518200751e-13 4.999999999999485 | 5.151434834260726e-13 5.999999999999506 | 4.938272013532696e-13 6.999999999999554 | 4.458655666894629e-13 7.999999999999551 | 4.494182803682634e-13 8.999999999999563 | 4.369837824924616e-13 9.999999999999536 | 4.636291350834654e-13 10.999999999999531 | 4.689582056016661e-13 11.999999999999533 | 4.671818487622659e-13 | Coud A = 9.18 w = 1.72 k = 164 0.999999999999453 | 5.466738173254271e-13 1.999999999999367 | 6.330491686412643e-13 2.999999999999333 | 6.674660824046441e-13 3.999999999999321 | 6.790124018607457e-13 4.999999999999317 | 6.830092047493963e-13 5.999999999999344 | 6.563638521583925e-13 6.999999999999456 | 5.435651928564766e-13 7.999999999999450 | 5.497824417943775e-13 8.999999999999426 | 5.737632591262809e-13 9.999999999999396 | 6.039613253960852e-13 10.999999999999382 | 6.181721801112872e-13 11.999999999999384 | 6.163958232718869e-13 |
| Coud A = 0.487 w = 1.72 k = 135 1.000000000000020 | -1.976196983832779e-14 2.000000000000021 | -2.131628207280301e-14 2.999999999999957 | 4.307665335545607e-14 4.000000000000021 | -2.131628207280301e-14 4.999999999999975 | 2.486899575160351e-14 5.999999999999985 | 1.509903313490213e-14 6.999999999999946 | 5.417888360170764e-14 7.999999999999976 | 2.398081733190338e-14 9.000000000000055 | -5.506706202140776e-14 10.000000000000011 | -1.065814103640150e-14 10.999999999999947 | 5.329070518200751e-14 12.000000000000034 | -3.375077994860476e-14 | Coud A = 0.6 w = 1.73 k = 161 1.000000000000035 | -3.463895836830488e-14 1.999999999999936 | 6.394884621840902e-14 3.000000000000017 | -1.687538997430238e-14 3.999999999999997 | 3.108624468950438e-15 4.999999999999968 | 3.197442310920451e-14 5.999999999999935 | 6.483702463810914e-14 7.000000000000013 | -1.332267629550188e-14 7.999999999999917 | 8.260059303211165e-14 8.999999999999973 | 2.664535259100376e-14 10.000000000000027 | -2.664535259100376e-14 10.999999999999982 | 1.776356839400250e-14 11.999999999999964 | 3.552713678800501e-14 |
| Coud A = 0.48 w = 1.73 k = 144 1.000000000000008 | -8.437694987151190e-15 2.000000000000025 | -2.486899575160351e-14 2.999999999999960 | 4.041211809635570e-14 4.000000000000014 | -1.421085471520200e-14 4.999999999999980 | 1.953992523340276e-14 6.000000000000009 | -8.881784197001252e-15 6.999999999999946 | 5.417888360170764e-14 7.999999999999983 | 1.687538997430238e-14 9.000000000000057 | -5.684341886080801e-14 9.999999999999998 | 1.776356839400250e-15 10.999999999999957 | 4.263256414560601e-14 12.000000000000034 | -3.375077994860476e-14 | Coud A = 0.51 w = 1.74 k = 174 1.000000000000041 | -4.085620730620576e-14 1.999999999999948 | 5.218048215738236e-14 3.000000000000048 | -4.751754545395670e-14 4.000000000000021 | -2.131628207280301e-14 4.999999999999963 | 3.730349362740526e-14 5.999999999999956 | 4.352074256530614e-14 7.000000000000008 | -7.993605777301127e-15 7.999999999999938 | 6.217248937900877e-14 8.999999999999996 | 3.552713678800501e-15 10.000000000000041 | -4.085620730620576e-14 10.999999999999982 | 1.776356839400250e-14 11.999999999999998 | 1.776356839400250e-15 |

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| w = 1.73 | B = 2 | B = 3 | B = 4 | B = 6 |
| k | 177 | 188 | 144 | 161 |

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| Метод Блочной релаксации b = 2 | Метод Блочной релаксации b = 4 |
| Coud A = 77.771 w = 0.1 k = 28592 0.999999999995172 | 4.828359934094806e-12 1.999999999994364 | 5.635714117602220e-12 2.999999999994089 | 5.911271472314183e-12 3.999999999993990 | 6.010303366110747e-12 4.999999999993962 | 6.037836897121451e-12 5.999999999994168 | 5.831779503751022e-12 6.999999999994666 | 5.333511410299252e-12 7.999999999994567 | 5.432987393305666e-12 8.999999999994378 | 5.622169396701793e-12 9.999999999994126 | 5.874412067896628e-12 10.999999999993985 | 6.014744258209248e-12 11.999999999993989 | 6.011191544530448e-12 | Coud A = 77.611 w = 0.1 k = 25182 0.999999999995185 | 4.815259302404229e-12 1.999999999994392 | 5.608180586591516e-12 2.999999999994105 | 5.894840171549731e-12 3.999999999993999 | 6.000977492703896e-12 4.999999999993972 | 6.028066934504750e-12 5.999999999994199 | 5.800693259061518e-12 6.999999999994694 | 5.305977879288548e-12 7.999999999994579 | 5.420552895429864e-12 8.999999999994396 | 5.604405828307790e-12 9.999999999994150 | 5.849543072145025e-12 10.999999999994010 | 5.989875262457645e-12 11.999999999994005 | 5.995204332975845e-12 |
| Coud A = 77.732 w = 0.2 k = 13535 0.999999999995182 | 4.818034859965792e-12 1.999999999994376 | 5.624167798146118e-12 2.999999999994103 | 5.897060617598981e-12 3.999999999994002 | 5.997868868234946e-12 4.999999999993975 | 6.024514220825949e-12 5.999999999994180 | 5.820233184294921e-12 6.999999999994678 | 5.321965090843150e-12 7.999999999994579 | 5.420552895429864e-12 8.999999999994399 | 5.600853114628990e-12 9.999999999994147 | 5.853095785823825e-12 10.999999999994003 | 5.996980689815246e-12 11.999999999994007 | 5.993427976136445e-12 | Coud A = 77.274 w = 0.2 k = 11920 0.999999999995216 | 4.783617946202412e-12 1.999999999994429 | 5.570877092964110e-12 2.999999999994145 | 5.854872142663226e-12 3.999999999994039 | 5.961453553027241e-12 4.999999999994009 | 5.990763440877345e-12 5.999999999994237 | 5.763389765434113e-12 6.999999999994730 | 5.269562564080843e-12 7.999999999994617 | 5.383249401802459e-12 8.999999999994436 | 5.563549621001584e-12 9.999999999994191 | 5.808686864838819e-12 10.999999999994049 | 5.950795411990839e-12 11.999999999994044 | 5.956124482509040e-12 |
| Coud A = 77.383 w = 0.3 k = 8519 0.999999999995201 | 4.798939023942239e-12 1.999999999994399 | 5.601297203838840e-12 2.999999999994130 | 5.870415265007978e-12 3.999999999994030 | 5.969891248014392e-12 4.999999999994005 | 5.995204332975845e-12 5.999999999994207 | 5.792699653284217e-12 6.999999999994704 | 5.296207916671847e-12 7.999999999994604 | 5.395683899678261e-12 8.999999999994426 | 5.574207762037986e-12 9.999999999994175 | 5.824674076393421e-12 10.999999999994037 | 5.963229909866641e-12 11.999999999994039 | 5.961453553027241e-12 | Coud A = 77.133 w = 0.3 k = 7499 0.999999999995221 | 4.778955009498986e-12 1.999999999994434 | 5.565770067050835e-12 2.999999999994152 | 5.848210804515475e-12 3.999999999994046 | 5.954348125669640e-12 4.999999999994020 | 5.980105299840943e-12 5.999999999994247 | 5.752731624397711e-12 6.999999999994738 | 5.261568958303542e-12 7.999999999994626 | 5.374367617605458e-12 8.999999999994447 | 5.552891479965183e-12 9.999999999994200 | 5.799805080641818e-12 10.999999999994060 | 5.940137270954438e-12 11.999999999994058 | 5.941913627793838e-12 |
| Coud A = 75.982 w = 0.4 k = 6014 0.999999999995276 | 4.724109992082504e-12 1.999999999994485 | 5.514921852523003e-12 2.999999999994224 | 5.775824263309914e-12 3.999999999994126 | 5.874412067896628e-12 4.999999999994102 | 5.897504706808832e-12 5.999999999994300 | 5.700329097635404e-12 6.999999999994790 | 5.210054609960935e-12 7.999999999994690 | 5.309530592967349e-12 8.999999999994518 | 5.481837206389173e-12 9.999999999994269 | 5.730527163905208e-12 10.999999999994138 | 5.861977570020827e-12 11.999999999994138 | 5.861977570020827e-12 | Coud A = 76.555 w = 0.4 k = 5290 0.999999999995261 | 4.739098002914943e-12 1.999999999994481 | 5.518918655411653e-12 2.999999999994201 | 5.798916902222118e-12 3.999999999994095 | 5.904610134166433e-12 4.999999999994071 | 5.928590951498336e-12 5.999999999994297 | 5.702993632894504e-12 6.999999999994786 | 5.214495502059435e-12 7.999999999994674 | 5.325517804521951e-12 8.999999999994499 | 5.501377131622576e-12 9.999999999994253 | 5.746514375459810e-12 10.999999999994117 | 5.883293852093630e-12 11.999999999994113 | 5.886846565772430e-12 |
| Coud A = 75.052 w = 0.5 k = 4511 0.999999999995377 | 4.622524585329302e-12 1.999999999994603 | 5.397016167307811e-12 2.999999999994349 | 5.650591106132197e-12 3.999999999994253 | 5.746514375459810e-12 4.999999999994231 | 5.768718835952313e-12 5.999999999994424 | 5.575984118877386e-12 6.999999999994906 | 5.093703236980218e-12 7.999999999994807 | 5.193179219986632e-12 8.999999999994641 | 5.359268584470556e-12 9.999999999994399 | 5.600853114628990e-12 10.999999999994269 | 5.730527163905208e-12 11.999999999994271 | 5.728750807065808e-12 | Coud A = 75.063 w = 0.5 k = 3965 0.999999999995328 | 4.672040532227584e-12 1.999999999994560 | 5.440314865268192e-12 2.999999999994285 | 5.714984041560456e-12 3.999999999994179 | 5.820677273504771e-12 4.999999999994158 | 5.841549466367724e-12 5.999999999994380 | 5.619504861442692e-12 6.999999999994863 | 5.137223979545524e-12 7.999999999994754 | 5.246469925168640e-12 8.999999999994584 | 5.416112003331364e-12 9.999999999994342 | 5.657696533489798e-12 10.999999999994206 | 5.794476010123617e-12 11.999999999994202 | 5.798028723802418e-12 |
| Coud A = 73.4 w = 0.6 k = 3509 0.999999999995492 | 4.507616502280598e-12 1.999999999994736 | 5.263789404352792e-12 2.999999999994492 | 5.507594380560477e-12 3.999999999994398 | 5.602185382258540e-12 4.999999999994379 | 5.621281218282093e-12 5.999999999994565 | 5.434763750145066e-12 6.999999999995037 | 4.963141009284300e-12 7.999999999994940 | 5.059952457031613e-12 8.999999999994779 | 5.220712750997336e-12 9.999999999994543 | 5.456968210637569e-12 10.999999999994420 | 5.579536832556187e-12 11.999999999994420 | 5.579536832556187e-12 | Coud A = 73.401 w = 0.6 k = 3082 0.999999999995435 | 4.564904010351256e-12 1.999999999994686 | 5.313749440460924e-12 2.999999999994419 | 5.581313189395587e-12 3.999999999994316 | 5.683897796870951e-12 4.999999999994297 | 5.702993632894504e-12 5.999999999994514 | 5.486278098487674e-12 6.999999999994985 | 5.014655357626907e-12 7.999999999994880 | 5.120348589571222e-12 8.999999999994715 | 5.284661597215745e-12 9.999999999994479 | 5.520917056855978e-12 10.999999999994348 | 5.652367462971597e-12 11.999999999994344 | 5.655920176650397e-12 |
| Coud A = 70.474 w = 0.7 k = 2794 0.999999999995674 | 4.325539926242072e-12 1.999999999994948 | 5.051514762044462e-12 2.999999999994718 | 5.282441151166495e-12 3.999999999994626 | 5.373923528395608e-12 4.999999999994609 | 5.391243007579760e-12 5.999999999994786 | 5.213607323639735e-12 6.999999999995242 | 4.757971794333571e-12 7.999999999995148 | 4.852118706821784e-12 8.999999999994998 | 5.002220859751105e-12 9.999999999994770 | 5.229594535194337e-12 10.999999999994655 | 5.345057729755354e-12 11.999999999994653 | 5.346834086594754e-12 | Coud A = 71.046 w = 0.7 k = 2452 0.999999999995610 | 4.390154906275257e-12 1.999999999994891 | 5.109468403929895e-12 2.999999999994634 | 5.365929922618307e-12 3.999999999994535 | 5.464961816414871e-12 4.999999999994518 | 5.481837206389173e-12 5.999999999994726 | 5.274003456179344e-12 6.999999999995182 | 4.818367926873179e-12 7.999999999995079 | 4.920508445138694e-12 8.999999999994927 | 5.073275133327115e-12 9.999999999994698 | 5.302425165609748e-12 10.999999999994571 | 5.428546501207165e-12 11.999999999994568 | 5.432099214885966e-12 |
| Coud A = 67.713 w = 0.8 k = 2256 0.999999999995812 | 4.188316360398403e-12 1.999999999995108 | 4.891864691103365e-12 2.999999999994889 | 5.111466805374221e-12 3.999999999994800 | 5.199840558134383e-12 4.999999999994786 | 5.214495502059435e-12 5.999999999994954 | 5.045741602316411e-12 6.999999999995399 | 4.600764214046649e-12 7.999999999995306 | 4.694022948115162e-12 8.999999999995163 | 4.837019673686882e-12 9.999999999994943 | 5.057287921772513e-12 10.999999999994834 | 5.165645688975928e-12 11.999999999994833 | 5.167422045815329e-12 | Coud A = 67.546 w = 0.8 k = 1979 0.999999999995803 | 4.196754055385554e-12 1.999999999995116 | 4.884093129930989e-12 2.999999999994873 | 5.127454016928823e-12 3.999999999994778 | 5.222045018626886e-12 4.999999999994765 | 5.234923605712538e-12 5.999999999994964 | 5.035971639699710e-12 6.999999999995400 | 4.599876035626949e-12 7.999999999995302 | 4.698463840213662e-12 8.999999999995158 | 4.842348744205083e-12 9.999999999994941 | 5.059064278611913e-12 10.999999999994822 | 5.178080186851730e-12 11.999999999994820 | 5.179856543691130e-12 |
| Coud A = 63.068 w = 0.9 k = 1839 0.999999999996084 | 3.916089674760315e-12 1.999999999995425 | 4.574784995270420e-12 2.999999999995223 | 4.777067630357124e-12 3.999999999995139 | 4.860556401808935e-12 4.999999999995129 | 4.870770453635487e-12 5.999999999995285 | 4.715339230187965e-12 6.999999999995704 | 4.296119016089506e-12 7.999999999995616 | 4.384048679639818e-12 8.999999999995486 | 4.513722728916036e-12 9.999999999995278 | 4.721556479125866e-12 10.999999999995183 | 4.817479748453479e-12 11.999999999995179 | 4.821032462132280e-12 | Coud A = 63.35 w = 0.9 k = 1611 0.999999999996051 | 3.949285343196607e-12 1.999999999995405 | 4.595435143528448e-12 2.999999999995176 | 4.824141086601230e-12 3.999999999995086 | 4.914291196200793e-12 4.999999999995078 | 4.922284801978094e-12 5.999999999995265 | 4.734879155421368e-12 6.999999999995677 | 4.322764368680510e-12 7.999999999995585 | 4.415134924329323e-12 8.999999999995454 | 4.545697152025241e-12 9.999999999995246 | 4.753530902235070e-12 10.999999999995136 | 4.863665026277886e-12 11.999999999995135 | 4.865441383117286e-12 |
| Coud A = 58.963 w = 1 k = 1505 0.999999999996397 | 3.602562692606170e-12 1.999999999995789 | 4.211075932403219e-12 2.999999999995608 | 4.392486374626969e-12 3.999999999995529 | 4.470646075560580e-12 4.999999999995522 | 4.478195592128031e-12 5.999999999995663 | 4.336975223395712e-12 6.999999999996054 | 3.946176718727656e-12 7.999999999995971 | 4.028777311759768e-12 8.999999999995856 | 4.144240506320784e-12 9.999999999995664 | 4.336087044976011e-12 10.999999999995577 | 4.423128530106624e-12 11.999999999995572 | 4.428457600624824e-12 | Coud A = 57.972 w = 1 k = 1317 0.999999999996412 | 3.588129793286043e-12 1.999999999995826 | 4.174216527985664e-12 2.999999999995620 | 4.379607787541318e-12 3.999999999995538 | 4.461764291363579e-12 4.999999999995532 | 4.467537451091630e-12 5.999999999995702 | 4.297895372928906e-12 6.999999999996078 | 3.922195901395753e-12 7.999999999995994 | 4.005684672847565e-12 8.999999999995881 | 4.119371510569181e-12 9.999999999995694 | 4.305888978706207e-12 10.999999999995595 | 4.405364961712621e-12 11.999999999995593 | 4.407141318552021e-12 |
| Coud A = 52.029 w = 1.1 k = 1231 0.999999999996750 | 3.249733815380296e-12 1.999999999996202 | 3.798295011847586e-12 2.999999999996043 | 3.956834859764058e-12 3.999999999995973 | 4.027000954920368e-12 4.999999999995969 | 4.030553668599168e-12 5.999999999996093 | 3.907096868260851e-12 6.999999999996449 | 3.550937321961101e-12 7.999999999996373 | 3.627320666055311e-12 8.999999999996273 | 3.726796649061725e-12 9.999999999996101 | 3.899103262483550e-12 10.999999999996028 | 3.971933892898960e-12 11.999999999996023 | 3.977262963417161e-12 | Coud A = 51.747 w = 1.1 k = 1076 0.999999999996832 | 3.168243445372809e-12 1.999999999996317 | 3.682609772681644e-12 2.999999999996137 | 3.863132036485695e-12 3.999999999996064 | 3.935518577691255e-12 4.999999999996063 | 3.937294934530655e-12 5.999999999996212 | 3.788080960021034e-12 6.999999999996545 | 3.455014052633487e-12 7.999999999996472 | 3.527844683048897e-12 8.999999999996376 | 3.623767952376511e-12 9.999999999996211 | 3.788969138440734e-12 10.999999999996124 | 3.876010623571347e-12 11.999999999996124 | 3.876010623571347e-12 |
| Coud A = 46.099 w = 1.2 k = 1002 0.999999999997161 | 2.838729251664063e-12 1.999999999996681 | 3.319344799024293e-12 2.999999999996547 | 3.452793606584237e-12 3.999999999996485 | 3.515410185173096e-12 4.999999999996485 | 3.514522006753396e-12 5.999999999996590 | 3.409716953228781e-12 6.999999999996906 | 3.093525435815536e-12 7.999999999996838 | 3.161915174132446e-12 8.999999999996756 | 3.243627588744857e-12 9.999999999996604 | 3.396394276933279e-12 10.999999999996545 | 3.455014052633487e-12 11.999999999996536 | 3.463895836830488e-12 | Coud A = 45.438 w = 1.2 k = 873 0.999999999997181 | 2.818523192615885e-12 1.999999999996725 | 3.275157922644212e-12 2.999999999996566 | 3.433697770560684e-12 3.999999999996501 | 3.498534795198793e-12 4.999999999996506 | 3.494093903100293e-12 5.999999999996638 | 3.361755318564974e-12 6.999999999996936 | 3.064215547965432e-12 7.999999999996871 | 3.129052572603541e-12 8.999999999996790 | 3.209876808796253e-12 9.999999999996643 | 3.357314426466473e-12 10.999999999996568 | 3.431921413721284e-12 11.999999999996568 | 3.431921413721284e-12 |
| Coud A = 39.767 w = 1.3 k = 807 0.999999999997608 | 2.391864484252437e-12 1.999999999997201 | 2.798650200475095e-12 2.999999999997095 | 2.904787521629260e-12 3.999999999997042 | 2.957634137601417e-12 4.999999999997047 | 2.953193245502916e-12 5.999999999997132 | 2.867928117211704e-12 6.999999999997403 | 2.597033699203166e-12 7.999999999997343 | 2.657429831742775e-12 8.999999999997279 | 2.721378677961184e-12 9.999999999997151 | 2.849276370398002e-12 10.999999999997105 | 2.895461648222408e-12 11.999999999997097 | 2.902567075580009e-12 | Coud A = 38.555 w = 1.3 k = 700 0.999999999997581 | 2.418953926053291e-12 1.999999999997189 | 2.811084698350896e-12 2.999999999997054 | 2.946087818145315e-12 3.999999999996998 | 3.002043058586423e-12 4.999999999997004 | 2.995825809648522e-12 5.999999999997117 | 2.883027150346607e-12 6.999999999997377 | 2.622790873374470e-12 7.999999999997322 | 2.677857935395878e-12 8.999999999997259 | 2.740918603194586e-12 9.999999999997131 | 2.868816295631405e-12 10.999999999997069 | 2.930988785010413e-12 11.999999999997069 | 2.930988785010413e-12 |
| Coud A = 32.317 w = 1.4 k = 637 0.999999999997995 | 2.004951760170570e-12 1.999999999997651 | 2.349231920106831e-12 2.999999999997570 | 2.430056156299543e-12 3.999999999997527 | 2.473132809654999e-12 4.999999999997534 | 2.465583293087548e-12 5.999999999997601 | 2.398969911610038e-12 6.999999999997834 | 2.166267165648605e-12 7.999999999997780 | 2.219557870830613e-12 8.999999999997733 | 2.266631327074720e-12 9.999999999997625 | 2.374989094278135e-12 10.999999999997595 | 2.405187160547939e-12 11.999999999997586 | 2.414068944744940e-12 | Coud A = 31.245 w = 1.4 k = 550 0.999999999998051 | 1.948663452822075e-12 1.999999999997737 | 2.262856568790994e-12 2.999999999997630 | 2.369660023759934e-12 3.999999999997583 | 2.417177569213891e-12 4.999999999997593 | 2.406963517387339e-12 5.999999999997685 | 2.315481140158226e-12 6.999999999997896 | 2.104094676269597e-12 7.999999999997853 | 2.146727240415203e-12 8.999999999997808 | 2.192024339819909e-12 9.999999999997705 | 2.295053036505124e-12 10.999999999997657 | 2.343014671168930e-12 11.999999999997657 | 2.343014671168930e-12 |
| Coud A = 25.19 w = 1.5 k = 487 0.999999999998439 | 1.560973572622970e-12 1.999999999998169 | 1.831423901421658e-12 2.999999999998113 | 1.886935052652916e-12 3.999999999998078 | 1.922462189440921e-12 4.999999999998086 | 1.914024494453770e-12 5.999999999998137 | 1.863398324530863e-12 6.999999999998325 | 1.675104499554436e-12 7.999999999998280 | 1.719513420539442e-12 8.999999999998252 | 1.747935129969846e-12 9.999999999998165 | 1.834976615100459e-12 10.999999999998147 | 1.852740183494461e-12 11.999999999998140 | 1.859845610852062e-12 | Coud A = 23.81 w = 1.5 k = 417 0.999999999998565 | 1.434741214723090e-12 1.999999999998336 | 1.663780224703260e-12 2.999999999998262 | 1.738165167353145e-12 3.999999999998228 | 1.772360036511600e-12 4.999999999998240 | 1.760369627845648e-12 5.999999999998304 | 1.695532603207539e-12 6.999999999998463 | 1.537436844500917e-12 7.999999999998433 | 1.566746732351021e-12 8.999999999998410 | 1.589839371263224e-12 9.999999999998332 | 1.667999072196835e-12 10.999999999998300 | 1.699973495306040e-12 11.999999999998298 | 1.701749852145440e-12 |
| Coud A = 18.318 w = 1.6 k = 350 0.999999999998863 | 1.136646332611235e-12 1.999999999998662 | 1.337818744673314e-12 2.999999999998636 | 1.363797963449542e-12 3.999999999998609 | 1.390887405250396e-12 4.999999999998622 | 1.378452907374594e-12 5.999999999998649 | 1.350919376363890e-12 6.999999999998796 | 1.204369937113370e-12 7.999999999998759 | 1.240785252321075e-12 8.999999999998744 | 1.255884285455977e-12 9.999999999998685 | 1.314504061156185e-12 10.999999999998680 | 1.319833131674386e-12 11.999999999998671 | 1.328714915871387e-12 | Coud A = 16.777 w = 1.6 k = 293 0.999999999998967 | 1.032618435203858e-12 1.999999999998803 | 1.197264509755769e-12 2.999999999998751 | 1.249222947308226e-12 3.999999999998726 | 1.274091943059830e-12 4.999999999998742 | 1.257660642295377e-12 5.999999999998789 | 1.210587186051271e-12 6.999999999998908 | 1.092459456231154e-12 7.999999999998885 | 1.114663916723657e-12 8.999999999998877 | 1.122657522500958e-12 9.999999999998820 | 1.179500941361766e-12 10.999999999998801 | 1.199040866595169e-12 11.999999999998797 | 1.202593580273970e-12 |
| Coud A = 10.803 w = 1.7 k = 214 0.999999999999297 | 7.033262861000367e-13 1.999999999999168 | 8.315570454442422e-13 2.999999999999170 | 8.300027332097670e-13 3.999999999999151 | 8.486544800234697e-13 4.999999999999167 | 8.331113576787175e-13 5.999999999999175 | 8.251177519014163e-13 6.999999999999279 | 7.212008767965017e-13 7.999999999999250 | 7.496225862269057e-13 8.999999999999256 | 7.442935157087049e-13 9.999999999999217 | 7.833733661755105e-13 10.999999999999226 | 7.744915819785092e-13 11.999999999999213 | 7.869260798543110e-13 | Coud A = 9.14 w = 1.7 k = 161 0.999999999999462 | 5.379030554308883e-13 1.999999999999382 | 6.183942247162122e-13 2.999999999999357 | 6.434852650727407e-13 3.999999999999340 | 6.599165658371930e-13 4.999999999999360 | 6.403766406037903e-13 5.999999999999381 | 6.190603585309873e-13 6.999999999999449 | 5.506706202140776e-13 7.999999999999440 | 5.595524044110789e-13 8.999999999999449 | 5.506706202140776e-13 9.999999999999419 | 5.808686864838819e-13 10.999999999999412 | 5.879741138414829e-13 11.999999999999412 | 5.879741138414829e-13 |
| Coud A = 0.55 w = 1.8 k = 354 1.000000000000011 | -1.088018564132653e-14 1.999999999999957 | 4.329869796038111e-14 3.000000000000016 | -1.598721155460225e-14 3.999999999999992 | 7.549516567451064e-15 5.000000000000040 | -3.996802888650564e-14 5.999999999999962 | 3.819167204710538e-14 7.000000000000028 | -2.842170943040401e-14 8.000000000000037 | -3.730349362740526e-14 8.999999999999956 | 4.440892098500626e-14 9.999999999999936 | 6.394884621840902e-14 11.000000000000037 | -3.730349362740526e-14 11.999999999999950 | 4.973799150320701e-1 | Coud A = 0.513 w = 1.8 k = 247 0.999999999999978 | 2.176037128265307e-14 2.000000000000045 | -4.485301019485632e-14 2.999999999999977 | 2.264854970235319e-14 3.999999999999981 | 1.865174681370263e-14 4.999999999999980 | 1.953992523340276e-14 6.000000000000062 | -6.217248937900877e-14 6.999999999999941 | 5.861977570020827e-14 8.000000000000014 | -1.421085471520200e-14 9.000000000000060 | -6.039613253960852e-14 9.999999999999963 | 3.730349362740526e-14 10.999999999999991 | 8.881784197001252e-15 12.000000000000005 | -5.329070518200751e-15 |
| w = 1.900000000000000 k = 100001  -nan(ind) | -nan(ind) | Coud A = 0.524 w = 1.9 k = 3453 0.999999999999963 | 3.652633751016765e-14 1.999999999999981 | 1.865174681370263e-14 3.000000000000016 | -1.598721155460225e-14 3.999999999999951 | 4.929390229335695e-14 4.999999999999996 | 3.552713678800501e-15 6.000000000000024 | -2.398081733190338e-14 7.000000000000034 | -3.375077994860476e-14 8.000000000000018 | -1.776356839400250e-14 8.999999999999941 | 5.861977570020827e-14 9.999999999999950 | 4.973799150320701e-14 11.000000000000037 | -3.730349362740526e-14 11.999999999999936 | 6.394884621840902e-14 |
|  | w = 2.000000000000000 k = 100001  -nan(ind) | -nan(ind) |

1. Матрица с обратными элементами на недиагональных элементах.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ax = F | 8 | 1 |  |  |  |  | 3 | 1 | 2 |  |  |  |  | 1 |  | 57 |
| 2 | 11 | 3 |  |  |  |  | 2 | 1 | 3 |  |  |  | 2 |  | 88 |
|  | 1 | 9 | 2 |  |  |  |  | 2 | 1 | 3 |  |  | 3 |  | 98 |
|  |  | 3 | 10 | 1 |  |  |  |  | 1 | 3 | 2 |  | 4 |  | 121 |
|  |  |  | 2 | 8 | 1 |  |  |  |  | 2 | 3 |  | 5 |  | 112 |
|  |  |  |  | 2 | 6 | 2 |  |  |  |  | 2 |  | 6 |  | 84 |
| 3 |  |  |  |  | 2 | 8 | 3 |  |  |  |  | \* | 7 | = | 95 |
| 2 | 3 |  |  |  |  | 1 | 8 | 2 |  |  |  |  | 8 |  | 97 |
| 1 | 3 | 2 |  |  |  |  | 3 | 10 | 1 |  |  |  | 9 |  | 137 |
|  | 2 | 1 | 3 |  |  |  |  | 2 | 9 | 1 |  |  | 10 |  | 138 |
|  |  | 2 | 1 | 3 |  |  |  |  | 2 | 11 | 3 |  | 11 |  | 202 |
|  |  |  | 3 | 1 | 2 |  |  |  |  | 1 | 7 |  | 12 |  | 124 |

|  |  |
| --- | --- |
| Метод Якоби | Метод Гаусса-Зейделя |
| Coud A = 4.53251 w = 0.1 k = 640 0.999999999999466 | 5.341282971471628e-13 2.000000000000406 | -4.058975378029572e-13 2.999999999999863 | 1.367794766338193e-13 4.000000000000028 | -2.842170943040401e-14 4.999999999999934 | 6.572520305780927e-14 5.999999999999536 | 4.636291350834654e-13 7.000000000000702 | -7.016609515630989e-13 7.999999999999766 | 2.344791028008331e-13 9.000000000000096 | -9.592326932761353e-14 9.999999999999794 | 2.060573933704291e-13 11.000000000000064 | -6.394884621840902e-14 12.000000000000195 | -1.953992523340276e-13 | Coud A = 4.583 w = 0.1 k = 624 0.999999999999469 | 5.306866057708248e-13 2.000000000000364 | -3.641531520770513e-13 2.999999999999903 | 9.725553695716371e-14 4.000000000000010 | -9.769962616701378e-15 4.999999999999946 | 5.417888360170764e-14 5.999999999999505 | 4.947153797729698e-13 7.000000000000687 | -6.865619184281968e-13 7.999999999999801 | 1.989519660128281e-13 9.000000000000078 | -7.815970093361102e-14 9.999999999999831 | 1.687538997430238e-13 11.000000000000020 | -1.953992523340276e-14 12.000000000000227 | -2.273736754432321e-13 |
| w = 0.200000000000000 k = 313 0.999999999999468 | 5.320188734003750e-13 2.000000000000392 | -3.916866830877552e-13 2.999999999999876 | 1.239008895481675e-13 4.000000000000020 | -2.042810365310288e-14 4.999999999999935 | 6.483702463810914e-14 5.999999999999526 | 4.742872761198669e-13 7.000000000000700 | -6.998845947236987e-13 7.999999999999776 | 2.238209617644316e-13 9.000000000000091 | -9.059419880941277e-14 9.999999999999806 | 1.936228954946273e-13 11.000000000000050 | -4.973799150320701e-14 12.000000000000211 | -2.113864638886298e-13 | w = 0.200000000000000 k = 296 0.999999999999452 | 5.475619957451272e-13 2.000000000000314 | -3.144151605738443e-13 2.999999999999963 | 3.685940441755520e-14 3.999999999999980 | 2.042810365310288e-14 4.999999999999958 | 4.174438572590589e-14 5.999999999999433 | 5.666578317686799e-13 7.000000000000695 | -6.945555242054979e-13 7.999999999999849 | 1.509903313490213e-13 9.000000000000055 | -5.506706202140776e-14 9.999999999999877 | 1.225686219186173e-13 10.999999999999948 | 5.151434834260726e-14 12.000000000000295 | -2.948752353404416e-13 |
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| w = 0.7 k = 79 0.999999999999533 | 4.666267372499533e-13 2.000000000000268 | -2.677857935395878e-13 2.999999999999973 | 2.664535259100376e-14 3.999999999999977 | 2.309263891220326e-14 4.999999999999955 | 4.529709940470639e-14 5.999999999999505 | 4.947153797729698e-13 7.000000000000624 | -6.235012506294879e-13 7.999999999999858 | 1.421085471520200e-13 9.000000000000052 | -5.151434834260726e-14 9.999999999999893 | 1.065814103640150e-13 10.999999999999948 | 5.151434834260726e-14 12.000000000000277 | -2.771116669464391e-13 | w = 0.700000000000000 k = 60 1.000000000000306 | -3.059774655866931e-13 1.999999999999508 | 4.916067553040193e-13 3.000000000000314 | -3.139710713639943e-13 3.999999999999920 | 7.993605777301127e-14 5.000000000000087 | -8.704148513061227e-14 6.000000000000025 | -2.486899575160351e-14 6.999999999999667 | 3.330669073875470e-13 8.000000000000252 | -2.522426711948356e-13 8.999999999999918 | 8.171241461241152e-14 10.000000000000233 | -2.327027459614328e-13 10.999999999999748 | 2.522426711948356e-13 12.000000000000096 | -9.592326932761353e-14 |
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|  |  |
| --- | --- |
| Метод Блочной релаксации b = 2 | Метод Блочной релаксации b = 4 |
| Coud A = 3.81 w = 0.1 k = 586 1.000000000000223 | -2.231548279496565e-13 2.000000000000297 | -2.970956813896919e-13 2.999999999999811 | 1.887379141862766e-13 4.000000000000156 | -1.563194018672220e-13 5.000000000000120 | -1.199040866595169e-13 6.000000000000452 | -4.520828156273637e-13 6.999999999999732 | 2.682298827494378e-13 7.999999999999680 | 3.197442310920451e-13 9.000000000000066 | -6.572520305780927e-14 9.999999999999762 | 2.380318164796336e-13 11.000000000000176 | -1.758593271006248e-13 11.999999999999558 | 4.423128530106624e-13 | Coud A = 3.223 w = 0.1 k = 530 1.000000000000060 | -6.039613253960852e-14 2.000000000000283 | -2.833289158843399e-13 2.999999999999990 | 9.769962616701378e-15 4.000000000000227 | -2.273736754432321e-13 5.000000000000234 | -2.344791028008331e-13 6.000000000000275 | -2.753353101070388e-13 6.999999999999976 | 2.398081733190338e-14 7.999999999999734 | 2.655653474903374e-13 9.000000000000011 | -1.065814103640150e-14 9.999999999999703 | 2.966515921798418e-13 10.999999999999995 | 5.329070518200751e-15 11.999999999999545 | 4.547473508864641e-13 |
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| Coud A = 3.86 w = 0.3 k = 176 1.000000000000291 | -2.913225216616411e-13 2.000000000000242 | -2.420286193682841e-13 2.999999999999859 | 1.412203687323199e-13 4.000000000000163 | -1.634248292248230e-13 5.000000000000156 | -1.563194018672220e-13 6.000000000000507 | -5.071498776487715e-13 6.999999999999673 | 3.268496584496461e-13 7.999999999999730 | 2.700062395888381e-13 9.000000000000032 | -3.197442310920451e-14 9.999999999999797 | 2.025046796916286e-13 11.000000000000130 | -1.296740492762183e-13 11.999999999999552 | 4.476419235288631e-13 | Coud A = 3.12 w = 0.3 k = 159 1.000000000000146 | -1.461053500406706e-13 2.000000000000202 | -2.016165012719284e-13 3.000000000000031 | -3.064215547965432e-14 4.000000000000198 | -1.980637875931279e-13 5.000000000000242 | -2.415845301584341e-13 6.000000000000269 | -2.691180611691379e-13 6.999999999999895 | 1.048050535246148e-13 7.999999999999802 | 1.980637875931279e-13 8.999999999999979 | 2.131628207280301e-14 9.999999999999782 | 2.184918912462308e-13 10.999999999999966 | 3.375077994860476e-14 11.999999999999613 | 3.872457909892546e-13 |
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| Coud A = 3.83 w = 0.6 k = 72 1.000000000000323 | -3.230749001659206e-13 2.000000000000122 | -1.216804434989172e-13 2.999999999999942 | 5.817568649035820e-14 4.000000000000134 | -1.341149413747189e-13 5.000000000000174 | -1.740829702612245e-13 6.000000000000480 | -4.796163466380676e-13 6.999999999999680 | 3.197442310920451e-13 7.999999999999846 | 1.536548666081217e-13 8.999999999999993 | 7.105427357601002e-15 9.999999999999886 | 1.136868377216160e-13 11.000000000000052 | -5.151434834260726e-14 11.999999999999650 | 3.499422973618493e-13 | Coud A = 3.03 w = 0.6 k = 64 1.000000000000302 | -3.024247519078926e-13 2.000000000000092 | -9.192646643896296e-14 3.000000000000103 | -1.034727858950646e-13 4.000000000000171 | -1.714184350021242e-13 5.000000000000282 | -2.815525590449397e-13 6.000000000000276 | -2.762234885267389e-13 6.999999999999781 | 2.193800696659309e-13 7.999999999999879 | 1.207922650792170e-13 8.999999999999940 | 6.039613253960852e-14 9.999999999999870 | 1.296740492762183e-13 10.999999999999920 | 7.993605777301127e-14 11.999999999999680 | 3.197442310920451e-13 |
| Coud A = 3.76 w = 0.7 k = 57 1.000000000000241 | -2.413624855535090e-13 2.000000000000060 | -6.039613253960852e-14 2.999999999999975 | 2.486899575160351e-14 4.000000000000091 | -9.148237722911290e-14 5.000000000000132 | -1.323385845353187e-13 6.000000000000346 | -3.455014052633487e-13 6.999999999999774 | 2.255973186038318e-13 7.999999999999912 | 8.792966355031240e-14 8.999999999999989 | 1.065814103640150e-14 9.999999999999938 | 6.217248937900877e-14 11.000000000000023 | -2.309263891220326e-14 11.999999999999767 | 2.327027459614328e-13 | Coud A = 3 w = 0.7 k = 50 1.000000000000314 | -3.141931159689193e-13 2.000000000000036 | -3.552713678800501e-14 3.000000000000114 | -1.141309269314661e-13 4.000000000000134 | -1.341149413747189e-13 5.000000000000253 | -2.531308496145357e-13 6.000000000000234 | -2.335909243811329e-13 6.999999999999782 | 2.184918912462308e-13 7.999999999999924 | 7.638334409421077e-14 8.999999999999940 | 6.039613253960852e-14 9.999999999999918 | 8.171241461241152e-14 10.999999999999918 | 8.171241461241152e-14 11.999999999999757 | 2.433608869978343e-13 |
| Coud A = 3.67 w = 0.8 k = 44 1.000000000000411 | -4.107825191113079e-13 2.000000000000056 | -5.639932965095795e-14 2.999999999999981 | 1.865174681370263e-14 4.000000000000138 | -1.376676550535194e-13 5.000000000000219 | -2.193800696659309e-13 6.000000000000563 | -5.631051180898794e-13 6.999999999999642 | 3.579359031391505e-13 7.999999999999894 | 1.056932319443149e-13 8.999999999999977 | 2.309263891220326e-14 9.999999999999924 | 7.638334409421077e-14 11.000000000000018 | -1.776356839400250e-14 11.999999999999657 | 3.428368700042483e-13 | Coud A = 2.98 w = 0.8 k = 39 1.000000000000311 | -3.106404022901188e-13 1.999999999999982 | 1.798561299892754e-14 3.000000000000117 | -1.167954621905665e-13 4.000000000000092 | -9.237055564881302e-14 5.000000000000213 | -2.131628207280301e-13 6.000000000000178 | -1.776356839400250e-13 6.999999999999798 | 2.016165012719284e-13 7.999999999999965 | 3.463895836830488e-14 8.999999999999948 | 5.151434834260726e-14 9.999999999999963 | 3.730349362740526e-14 10.999999999999924 | 7.638334409421077e-14 11.999999999999835 | 1.652011860642233e-13 |
| Coud A = 3.487 w = 0.9 k = 34 1.000000000000389 | -3.892441924335799e-13 2.000000000000004 | -3.996802888650564e-15 3.000000000000001 | -1.332267629550188e-15 4.000000000000113 | -1.127986593019159e-13 5.000000000000210 | -2.096101070492296e-13 6.000000000000514 | -5.142553050063725e-13 6.999999999999693 | 3.073097332162433e-13 7.999999999999937 | 6.306066779870889e-14 8.999999999999977 | 2.309263891220326e-14 9.999999999999959 | 4.085620730620576e-14 11.000000000000000 | 0.000000000000000e+00 11.999999999999730 | 2.700062395888381e-13 | Coud A = 2.98 w = 0.9 k = 30 1.000000000000195 | -1.949551631241775e-13 1.999999999999955 | 4.485301019485632e-14 3.000000000000075 | -7.549516567451064e-14 4.000000000000033 | -3.286260152890463e-14 5.000000000000107 | -1.065814103640150e-13 6.000000000000078 | -7.815970093361102e-14 6.999999999999886 | 1.136868377216160e-13 7.999999999999998 | 1.776356839400250e-15 8.999999999999973 | 2.664535259100376e-14 9.999999999999998 | 1.776356839400250e-15 10.999999999999957 | 4.263256414560601e-14 11.999999999999940 | 6.039613253960852e-14 |
| Coud A = 3.16 w = 1 k = 25 1.000000000000255 | -2.553512956637860e-13 1.999999999999967 | 3.330669073875470e-14 3.000000000000009 | -8.881784197001252e-15 4.000000000000054 | -5.417888360170764e-14 5.000000000000137 | -1.367794766338193e-13 6.000000000000325 | -3.250733016102458e-13 6.999999999999831 | 1.687538997430238e-13 7.999999999999980 | 2.042810365310288e-14 8.999999999999991 | 8.881784197001252e-15 9.999999999999995 | 5.329070518200751e-15 10.999999999999995 | 5.329070518200751e-15 11.999999999999867 | 1.332267629550188e-13 | Coud A = 2.93 w = 1 k = 20 1.000000000000215 | -2.147171329625053e-13 1.999999999999904 | 9.592326932761353e-14 3.000000000000070 | -6.972200594645983e-14 3.999999999999996 | 3.996802888650564e-15 5.000000000000062 | -6.217248937900877e-14 6.000000000000032 | -3.197442310920451e-14 6.999999999999907 | 9.325873406851315e-14 8.000000000000011 | -1.065814103640150e-14 8.999999999999988 | 1.243449787580175e-14 10.000000000000021 | -2.131628207280301e-14 10.999999999999968 | 3.197442310920451e-14 11.999999999999989 | 1.065814103640150e-14 |
| Coud A = 2.37 w = 1.1 k = 22 1.000000000000084 | -8.415490526658687e-14 1.999999999999606 | 3.943512183468556e-13 3.000000000000116 | -1.159072837708663e-13 3.999999999999956 | 4.396483177515620e-14 4.999999999999950 | 4.973799150320701e-14 6.000000000000001 | -8.881784197001252e-16 6.999999999999885 | 1.154631945610163e-13 8.000000000000183 | -1.829647544582258e-13 9.000000000000052 | -5.151434834260726e-14 10.000000000000101 | -1.012523398458143e-13 10.999999999999991 | 8.881784197001252e-15 11.999999999999998 | 1.776356839400250e-15 | Coud A = 2.06 w = 1.1 k = 17 1.000000000000342 | -3.421707361894732e-13 1.999999999999797 | 2.033928581113287e-13 3.000000000000059 | -5.861977570020827e-14 3.999999999999936 | 6.439293542825908e-14 5.000000000000203 | -2.033928581113287e-13 5.999999999999993 | 7.105427357601002e-15 7.000000000000027 | -2.664535259100376e-14 7.999999999999896 | 1.039168751049147e-13 9.000000000000025 | -2.486899575160351e-14 10.000000000000032 | -3.197442310920451e-14 10.999999999999972 | 2.842170943040401e-14 12.000000000000071 | -7.105427357601002e-14 |
| Coud A = 1.78 w = 1.2 k = 28 0.999999999999948 | 5.151434834260726e-14 2.000000000000207 | -2.073896609999792e-13 3.000000000000080 | -7.993605777301127e-14 3.999999999999973 | 2.664535259100376e-14 4.999999999999991 | 8.881784197001252e-15 5.999999999999850 | 1.501021529293212e-13 7.000000000000031 | -3.108624468950438e-14 8.000000000000030 | -3.019806626980426e-14 8.999999999999922 | 7.815970093361102e-14 10.000000000000007 | -7.105427357601002e-15 10.999999999999959 | 4.085620730620576e-14 12.000000000000073 | -7.283063041541027e-14 | Coud A = 1.94 w = 1.2 k = 23 1.000000000000131 | -1.307842723008434e-13 1.999999999999962 | 3.819167204710538e-14 2.999999999999951 | 4.929390229335695e-14 4.000000000000110 | -1.101341240428155e-13 5.000000000000160 | -1.598721155460225e-13 6.000000000000090 | -8.970602038971265e-14 7.000000000000016 | -1.598721155460225e-14 7.999999999999907 | 9.325873406851315e-14 9.000000000000030 | -3.019806626980426e-14 9.999999999999963 | 3.730349362740526e-14 10.999999999999986 | 1.421085471520200e-14 11.999999999999952 | 4.796163466380676e-14 |
| Coud A = 2.6 w = 1.3 k = 37 1.000000000000041 | -4.107825191113079e-14 1.999999999999867 | 1.334488075599438e-13 3.000000000000077 | -7.727152251391090e-14 3.999999999999975 | 2.531308496145357e-14 4.999999999999979 | 2.131628207280301e-14 5.999999999999985 | 1.509903313490213e-14 6.999999999999918 | 8.171241461241152e-14 8.000000000000105 | -1.048050535246148e-13 9.000000000000030 | -3.019806626980426e-14 10.000000000000050 | -4.973799150320701e-14 10.999999999999998 | 1.776356839400250e-15 11.999999999999984 | 1.598721155460225e-14 | Coud A = 2.358 w = 1.3 k = 31 0.999999999999704 | 2.959854583650667e-13 2.000000000000292 | -2.917666108714911e-13 2.999999999999951 | 4.884981308350689e-14 4.000000000000018 | -1.776356839400250e-14 5.000000000000039 | -3.907985046680551e-14 5.999999999999970 | 3.019806626980426e-14 7.000000000000138 | -1.376676550535194e-13 7.999999999999921 | 7.904787935331115e-14 8.999999999999885 | 1.154631945610163e-13 9.999999999999979 | 2.131628207280301e-14 10.999999999999984 | 1.598721155460225e-14 12.000000000000055 | -5.506706202140776e-14 |
| Coud A = 2.48 w = 1.4 k = 49 1.000000000000083 | -8.282263763703668e-14 1.999999999999768 | 2.315925229368077e-13 3.000000000000053 | -5.284661597215745e-14 3.999999999999985 | 1.509903313490213e-14 4.999999999999982 | 1.776356839400250e-14 6.000000000000060 | -6.039613253960852e-14 6.999999999999873 | 1.270095140171179e-13 8.000000000000107 | -1.065814103640150e-13 9.000000000000080 | -7.993605777301127e-14 10.000000000000050 | -4.973799150320701e-14 11.000000000000030 | -3.019806626980426e-14 11.999999999999925 | 7.460698725481052e-14 | Coud A = 2.03 w = 1.4 k = 42 0.999999999999936 | 6.350475700855895e-14 2.000000000000066 | -6.616929226765933e-14 3.000000000000176 | -1.758593271006248e-13 3.999999999999894 | 1.061373211541650e-13 4.999999999999912 | 8.792966355031240e-14 6.000000000000021 | -2.131628207280301e-14 6.999999999999711 | 2.886579864025407e-13 8.000000000000211 | -2.113864638886298e-13 8.999999999999886 | 1.136868377216160e-13 10.000000000000131 | -1.314504061156185e-13 10.999999999999950 | 4.973799150320701e-14 12.000000000000027 | -2.664535259100376e-14 |
| Coud A = 2.55 w = 1.5 k = 67 1.000000000000123 | -1.232347557333924e-13 1.999999999999689 | 3.113065361048939e-13 3.000000000000214 | -2.140509991477302e-13 3.999999999999935 | 6.528111384795920e-14 4.999999999999953 | 4.707345624410664e-14 5.999999999999967 | 3.286260152890463e-14 6.999999999999727 | 2.726707748479384e-13 8.000000000000282 | -2.824407374646398e-13 9.000000000000080 | -7.993605777301127e-14 10.000000000000139 | -1.385558334732195e-13 11.000000000000011 | -1.065814103640150e-14 11.999999999999917 | 8.348877145181177e-14 | Coud A = 2.563 w = 1.5 k = 60 0.999999999999640 | 3.597122599785507e-13 2.000000000000292 | -2.922107000813412e-13 2.999999999999946 | 5.373479439185758e-14 3.999999999999991 | 8.881784197001252e-15 5.000000000000013 | -1.332267629550188e-14 5.999999999999929 | 7.105427357601002e-14 7.000000000000218 | -2.184918912462308e-13 7.999999999999909 | 9.148237722911290e-14 8.999999999999860 | 1.403321903126198e-13 9.999999999999995 | 5.329070518200751e-15 10.999999999999980 | 1.953992523340276e-14 12.000000000000094 | -9.414691248821327e-14 |
| Coud A = 2.235 w = 1.6 k = 91 1.000000000000364 | -3.641531520770513e-13 1.999999999999994 | 6.217248937900877e-15 3.000000000000154 | -1.540989558179717e-13 3.999999999999964 | 3.552713678800501e-14 4.999999999999969 | 3.108624468950438e-14 6.000000000000179 | -1.785238623597252e-13 6.999999999999924 | 7.638334409421077e-14 7.999999999999776 | 2.238209617644316e-13 8.999999999999845 | 1.545430450278218e-13 9.999999999999954 | 4.618527782440651e-14 10.999999999999883 | 1.172395514004165e-13 11.999999999999819 | 1.811883976188255e-13 | Coud A = 3.02843 w = 1.6 k = 92 0.999999999999723 | 2.772226892489016e-13 2.000000000000254 | -2.544631172440859e-13 2.999999999999856 | 1.438849039914203e-13 4.000000000000028 | -2.753353101070388e-14 5.000000000000068 | -6.750155989720952e-14 5.999999999999947 | 5.329070518200751e-14 7.000000000000363 | -3.632649736573512e-13 7.999999999999788 | 2.122746423083299e-13 8.999999999999943 | 5.684341886080801e-14 9.999999999999943 | 5.684341886080801e-14 10.999999999999989 | 1.065814103640150e-14 12.000000000000083 | -8.348877145181177e-14 |
| Coud A = 2.47 w = 1.7 k = 184 0.999999999999866 | 1.336708521648688e-13 2.000000000000282 | -2.819966482547898e-13 2.999999999999778 | 2.224886941348814e-13 4.000000000000064 | -6.394884621840902e-14 5.000000000000047 | -4.707345624410664e-14 6.000000000000034 | -3.375077994860476e-14 7.000000000000322 | -3.215205879314453e-13 7.999999999999710 | 2.895461648222408e-13 8.999999999999920 | 7.993605777301127e-14 9.999999999999847 | 1.527666881884215e-13 10.999999999999980 | 1.953992523340276e-14 12.000000000000114 | -1.136868377216160e-13 | Coud A = 1.705 w = 1.7 k = 174 0.999999999999954 | 4.607425552194400e-14 2.000000000000170 | -1.696420781627239e-13 3.000000000000055 | -5.506706202140776e-14 3.999999999999825 | 1.749711486809247e-13 5.000000000000052 | -5.151434834260726e-14 6.000000000000135 | -1.350031197944190e-13 6.999999999999860 | 1.403321903126198e-13 7.999999999999914 | 8.615330671091215e-14 9.000000000000059 | -5.861977570020827e-14 10.000000000000187 | -1.865174681370263e-13 10.999999999999845 | 1.545430450278218e-13 12.000000000000060 | -6.039613253960852e-14 |
| Coud A = 2.367 w = 1.8 k = 668 0.999999999999887 | 1.126876369994534e-13 2.000000000000199 | -1.985078768029780e-13 3.000000000000200 | -2.002842336423782e-13 3.999999999999929 | 7.149836278586008e-14 4.999999999999971 | 2.930988785010413e-14 5.999999999999674 | 3.259614800299460e-13 7.000000000000026 | -2.575717417130363e-14 8.000000000000123 | -1.225686219186173e-13 8.999999999999780 | 2.202682480856311e-13 10.000000000000096 | -9.592326932761353e-14 10.999999999999847 | 1.527666881884215e-13 12.000000000000197 | -1.971756091734278e-13 | Coud A = 1.86 w = 1.8 k = 1311 0.999999999999968 | 3.153033389935445e-14 1.999999999999845 | 1.549871342376719e-13 3.000000000000023 | -2.264854970235319e-14 4.000000000000153 | -1.527666881884215e-13 4.999999999999887 | 1.127986593019159e-13 5.999999999999836 | 1.643130076445232e-13 7.000000000000041 | -4.085620730620576e-14 8.000000000000217 | -2.167155344068306e-13 8.999999999999819 | 1.811883976188255e-13 9.999999999999854 | 1.456612608308205e-13 11.000000000000174 | -1.740829702612245e-13 11.999999999999952 | 4.796163466380676e-14 |
| w = 1.900000000000000 k = 1000001  -nan(ind) | -nan(ind)  -nan(ind) | -nan(ind) | w = 1.900000000000000 k = 1000001  -nan(ind) | -nan(ind)  -nan(ind) | -nan(ind) |

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| Определение оптимального веса. | |
| Метод Якоби | Метод Гаусса-Зейделя |
| Coud A = 4.7069 w = 0.79 k = 68 0.999999999999509 | 4.913847106990943e-13 2.000000000000263 | -2.633449014410871e-13 2.999999999999993 | 7.105427357601002e-15 3.999999999999964 | 3.552713678800501e-14 4.999999999999957 | 4.263256414560601e-14 5.999999999999458 | 5.417888360170764e-13 7.000000000000662 | -6.616929226765933e-13 7.999999999999866 | 1.341149413747189e-13 9.000000000000044 | -4.440892098500626e-14 9.999999999999901 | 9.947598300641403e-14 10.999999999999925 | 7.460698725481052e-14 12.000000000000316 | -3.161915174132446e-13 | Coud A = 3.4368 w = 1.06 k = 27 1.000000000000184 | -1.842970220877760e-13 1.999999999999999 | 8.881784197001252e-16 2.999999999999924 | 7.593925488436071e-14 4.000000000000011 | -1.065814103640150e-14 4.999999999999942 | 5.773159728050814e-14 6.000000000000224 | -2.238209617644316e-13 6.999999999999901 | 9.858780458671390e-14 7.999999999999967 | 3.286260152890463e-14 9.000000000000002 | -1.776356839400250e-15 9.999999999999980 | 1.953992523340276e-14 11.000000000000085 | -8.526512829121202e-14 11.999999999999932 | 6.750155989720952e-14 |
| Coud A = 4.4556 w = 0.805 k = 67 0.999999999999631 | 3.694822225952521e-13 2.000000000000210 | -2.096101070492296e-13 3.000000000000017 | -1.687538997430238e-14 3.999999999999982 | 1.776356839400250e-14 4.999999999999983 | 1.687538997430238e-14 5.999999999999586 | 4.138911435802584e-13 7.000000000000528 | -5.275779813018744e-13 7.999999999999915 | 8.526512829121202e-14 9.000000000000044 | -4.440892098500626e-14 9.999999999999947 | 5.329070518200751e-14 10.999999999999947 | 5.329070518200751e-14 12.000000000000270 | -2.700062395888381e-13 | Coud A = 1.53 w = 1.09 k = 26 0.999999999999899 | 1.011413175433518e-13 2.000000000000088 | -8.792966355031240e-14 2.999999999999935 | 6.483702463810914e-14 3.999999999999915 | 8.482103908136196e-14 4.999999999999979 | 2.131628207280301e-14 5.999999999999877 | 1.225686219186173e-13 6.999999999999928 | 7.194245199571014e-14 7.999999999999918 | 8.171241461241152e-14 9.000000000000007 | -7.105427357601002e-15 10.000000000000002 | -1.776356839400250e-15 10.999999999999922 | 7.815970093361102e-14 12.000000000000068 | -6.750155989720952e-14 |
| Coud A = 0.9465 w = 0.82 k = 71 1.000000000000019 | -1.909583602355269e-14 2.000000000000068 | -6.794564910705958e-14 3.000000000000065 | -6.483702463810914e-14 4.000000000000055 | -5.506706202140776e-14 5.000000000000060 | -6.039613253960852e-14 6.000000000000020 | -2.042810365310288e-14 7.000000000000095 | -9.503509090791340e-14 8.000000000000050 | -4.973799150320701e-14 9.000000000000057 | -5.684341886080801e-14 10.000000000000059 | -5.861977570020827e-14 11.000000000000052 | -5.151434834260726e-14 12.000000000000085 | -8.526512829121202e-14 | Coud A = 1.583 w = 1.12 k = 28 0.999999999999869 | 1.312283615106935e-13 1.999999999999961 | 3.863576125695545e-14 2.999999999999896 | 1.039168751049147e-13 3.999999999999960 | 3.996802888650564e-14 4.999999999999988 | 1.243449787580175e-14 5.999999999999902 | 9.769962616701378e-14 6.999999999999927 | 7.283063041541027e-14 8.000000000000021 | -2.131628207280301e-14 9.000000000000041 | -4.085620730620576e-14 10.000000000000007 | -7.105427357601002e-15 11.000000000000009 | -8.881784197001252e-15 12.000000000000050 | -4.973799150320701e-14 |

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| Определение оптимального веса, для блочной релаксации | |
| B = 2 | B = 3 |
| Coud A = 2.82 w = 1.03 k = 22 1.000000000000220 | -2.204902926905561e-13 2.000000000000032 | -3.241851231905457e-14 2.999999999999998 | 2.220446049250313e-15 4.000000000000048 | -4.796163466380676e-14 5.000000000000131 | -1.305622276959184e-13 6.000000000000285 | -2.851052727237402e-13 6.999999999999876 | 1.243449787580175e-13 7.999999999999959 | 4.085620730620576e-14 8.999999999999982 | 1.776356839400250e-14 9.999999999999980 | 1.953992523340276e-14 10.999999999999998 | 1.776356839400250e-15 11.999999999999892 | 1.083577672034153e-13 | Coud A = 2.71 w = 1.05 k = 19 1.000000000000010 | -9.769962616701378e-15 1.999999999999921 | 7.882583474838611e-14 3.000000000000107 | -1.074695887837152e-13 3.999999999999952 | 4.796163466380676e-14 4.999999999999969 | 3.108624468950438e-14 5.999999999999934 | 6.572520305780927e-14 7.000000000000001 | -8.881784197001252e-16 8.000000000000025 | -2.486899575160351e-14 8.999999999999982 | 1.776356839400250e-14 10.000000000000023 | -2.309263891220326e-14 10.999999999999980 | 1.953992523340276e-14 12.000000000000037 | -3.730349362740526e-14 |
| Coud A = 2.47 w = 1.05 k = 21 1.000000000000034 | -3.352873534367973e-14 1.999999999999970 | 3.042011087472929e-14 3.000000000000122 | -1.216804434989172e-13 3.999999999999966 | 3.419486915845482e-14 4.999999999999983 | 1.687538997430238e-14 5.999999999999916 | 8.437694987151190e-14 6.999999999999969 | 3.108624468950438e-14 8.000000000000094 | -9.414691248821327e-14 8.999999999999964 | 3.552713678800501e-14 10.000000000000036 | -3.552713678800501e-14 10.999999999999970 | 3.019806626980426e-14 12.000000000000041 | -4.085620730620576e-14 | Coud A = 2.88 w = 1.06 k = 17 1.000000000000344 | -3.439470930288735e-13 1.999999999999895 | 1.052491427344648e-13 3.000000000000110 | -1.096900348329655e-13 4.000000000000090 | -8.970602038971265e-14 5.000000000000099 | -9.947598300641403e-14 6.000000000000330 | -3.295141937087465e-13 6.999999999999836 | 1.643130076445232e-13 7.999999999999973 | 2.664535259100376e-14 8.999999999999980 | 1.953992523340276e-14 9.999999999999977 | 2.309263891220326e-14 11.000000000000005 | -5.329070518200751e-15 11.999999999999856 | 1.438849039914203e-13 |
| Coud A = 1.85 w = 1.08 k = 22 0.999999999999971 | 2.853273173286652e-14 2.000000000000150 | -1.496580637194711e-13 3.000000000000009 | -8.881784197001252e-15 3.999999999999999 | 8.881784197001252e-16 5.000000000000007 | -7.105427357601002e-15 5.999999999999948 | 5.151434834260726e-14 7.000000000000034 | -3.375077994860476e-14 7.999999999999974 | 2.575717417130363e-14 8.999999999999964 | 3.552713678800501e-14 9.999999999999979 | 2.131628207280301e-14 10.999999999999996 | 3.552713678800501e-15 12.000000000000018 | -1.776356839400250e-14 | Coud A = 2.52 w = 1.12 k = 18 1.000000000000082 | -8.215650382226158e-14 2.000000000000110 | -1.096900348329655e-13 2.999999999999827 | 1.731947918415244e-13 4.000000000000116 | -1.163513729807164e-13 5.000000000000082 | -8.171241461241152e-14 6.000000000000210 | -2.096101070492296e-13 6.999999999999980 | 2.042810365310288e-14 7.999999999999948 | 5.240252676230739e-14 9.000000000000043 | -4.263256414560601e-14 9.999999999999959 | 4.085620730620576e-14 11.000000000000046 | -4.618527782440651e-14 11.999999999999917 | 8.348877145181177e-14 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Определение оптимального веса, для блочной релаксации | | | | | | | |
| B = 4 | | | | B = 6 | | | |
| Coud A = 2.88 w = 1.02 k = 17 0.999999999999814 | 1.860733789271762e-13 2.000000000000195 | -1.945110739143274e-13 2.999999999999877 | 1.225686219186173e-13 4.000000000000036 | -3.552713678800501e-14 4.999999999999933 | 6.661338147750939e-14 6.000000000000018 | -1.776356839400250e-14 7.000000000000076 | -7.638334409421077e-14 7.999999999999951 | 4.884981308350689e-14 9.000000000000005 | -5.329070518200751e-15 9.999999999999956 | 4.440892098500626e-14 11.000000000000046 | -4.618527782440651e-14 11.999999999999984 | 1.598721155460225e-14 | | | | Coud A = 2.36 w = 1.07 k = 18 1.000000000000052 | -5.195843755245733e-14 2.000000000000010 | -9.769962616701378e-15 3.000000000000002 | -1.776356839400250e-15 4.000000000000028 | -2.753353101070388e-14 5.000000000000036 | -3.641531520770513e-14 6.000000000000074 | -7.371880883511039e-14 6.999999999999977 | 2.309263891220326e-14 7.999999999999992 | 7.993605777301127e-15 8.999999999999998 | 1.776356839400250e-15 9.999999999999993 | 7.105427357601002e-15 10.999999999999998 | 1.776356839400250e-15 11.999999999999975 | 2.486899575160351e-14 | | | |
| Coud A = 2.79 w = 1.04 k = 16 1.000000000000347 | -3.470557174978239e-13 1.999999999999708 | 2.924327446862662e-13 3.000000000000166 | -1.660893644839234e-13 3.999999999999915 | 8.526512829121202e-14 5.000000000000035 | -3.463895836830488e-14 5.999999999999948 | 5.240252676230739e-14 6.999999999999887 | 1.127986593019159e-13 8.000000000000073 | -7.283063041541027e-14 8.999999999999995 | 5.329070518200751e-15 10.000000000000068 | -6.750155989720952e-14 10.999999999999956 | 4.440892098500626e-14 12.000000000000048 | -4.796163466380676e-14 | | | | Coud A = 1.88 w = 1.1 k = 15 0.999999999999878 | 1.223465773136923e-13 2.000000000000055 | -5.462297281155770e-14 3.000000000000005 | -5.329070518200751e-15 3.999999999999932 | 6.794564910705958e-14 4.999999999999934 | 6.572520305780927e-14 6.000000000000050 | -4.973799150320701e-14 7.000000000000017 | -1.687538997430238e-14 7.999999999999954 | 4.618527782440651e-14 8.999999999999988 | 1.243449787580175e-14 10.000000000000030 | -3.019806626980426e-14 11.000000000000002 | -1.776356839400250e-15 11.999999999999993 | 7.105427357601002e-15 | | | |
| Coud A = 2.31 w = 1.08 k = 17 0.999999999999965 | 3.463895836830488e-14 1.999999999999998 | 2.442490654175344e-15 2.999999999999981 | 1.865174681370263e-14 4.000000000000028 | -2.753353101070388e-14 4.999999999999981 | 1.865174681370263e-14 6.000000000000013 | -1.332267629550188e-14 6.999999999999993 | 7.105427357601002e-15 8.000000000000011 | -1.065814103640150e-14 9.000000000000009 | -8.881784197001252e-15 9.999999999999995 | 5.329070518200751e-15 11.000000000000005 | -5.329070518200751e-15 11.999999999999980 | 1.953992523340276e-14 | | | | Coud A = 2.36 w = 1.12 k = 16 1.000000000000007 | -7.327471962526033e-15 1.999999999999877 | 1.234568003383174e-13 2.999999999999963 | 3.685940441755520e-14 4.000000000000017 | -1.687538997430238e-14 4.999999999999964 | 3.641531520770513e-14 5.999999999999673 | 3.268496584496461e-13 7.000000000000010 | -9.769962616701378e-15 8.000000000000098 | -9.769962616701378e-14 9.000000000000030 | -3.019806626980426e-14 9.999999999999956 | 4.440892098500626e-14 11.000000000000012 | -1.243449787580175e-14 12.000000000000057 | -5.684341886080801e-14 | | | |
|  | | | |  | | | |
| w = 1.1 | B = 2 | B = 3 | | B = 4 | B = 6 |
| k | 22 | 17 | | 17 | 15 |

1. Текст программы.

/\*Includs.h\*/

#include<iostream>

#include<fstream>

#include<vector>

#include<cmath>

#include<conio.h>

#include<numeric>

#include<cstdlib>

#include <io.h>

#include <fcntl.h>

#include <iomanip>

#ifdef \_WIN32

#include <windows.h>

#include <wincon.h>

#endif

#define max(a, b) ((a > b ? a : b))

using namespace std;

/\*Matrix.h\*/

#pragma once

#include "includs.h"

#include "matrix (2).cpp"

template<class T>

class Matrix

{

public:

Matrix() { maxiter = 10; d = k = n = m = Error = 0; e = 0.001; w = 1; }

~Matrix(){}

//Матрица A, хранящаяся как одномерный массив

T matrix(size\_t i,size\_t j);

//х Уравнения Ax = F

vector<T> result;

//Левая часть равенство Ах = F, (F - f) - нвязка

vector<T> F, f;

//Инжексы диагоналей (общий случий)

vector<int> Index;

size\_t k;

//эпсиол и омега

T e, w;

//Максимальное количество итерация

size\_t maxiter;

//Получение информации об ошибке

size\_t GetLastError();

void GetResult();

void SetMatrix();

//Открытие файлов

void OpenMatrix();

//Сохранение результата

void SaveResult();

//Метод Якоби

void JacobiMethod();

//Метода Зиделя

void GaussSeidelMethod();

//Метод релаксации с квадратным блоком стороной NBlock

void BlockRelax(int Nblock);

private:

//Факторизация

vector<T> Fractorization(int Nblock);

//Норма вектора (L2)

inline T NormVector(vector<T>);

//Умножение матрицы matrix на вектор X

vector<T> MultMatrixAandVector(vector<T> X);

//Разность векторов a и b

vector<T> ResidualVectors(vector<T> a, vector<T> b);

//Добавление результата для метода Зиделя

void Gaussnewvector(vector<T> &f, T x, int i);

//Добавление результата для метода релаксации

void Blocknewvector(vector<T> &f, T x, int i, int Max);

//Проверка на выход

inline bool CheckEnd();

//Функция параметра релаксивности

T RelaxParam(T x2, T x1);

#ifdef \_DEBUG

T a[100000]; //Максимальный размер 1000 на 100

const int MAX = 100000;

#else

T a[100000]; //Максимальный размер 1000 на 100

const int MAX = 100000;

#endif // DEBUG

vector<T> buf;

size\_t n, m;

size\_t Error;

size\_t d;

};

/\*Errors:

0 - not error

1 - matrix overflow

2 - end method

\*/

/\*Matrix.cpp\*/

#include "includs.h"

#include "Matrix.h"

template<class T>

inline T Matrix<T>::matrix(size\_t i, size\_t j)

{

if (!n)

return false;

return a[i \* n + j];

}

template<class T>

size\_t Matrix<T>::GetLastError()

{

return Error;

}

template<class T>

void Matrix<T>::OpenMatrix()

{

ifstream index("index.txt");

index >> n;

index >> m;

k = 0;

Error = 0;

if (n \* m > MAX)

{

Error = 1;

return;

}

Index.resize(m);

F.resize(n);

result.resize(n, 0);

for (size\_t i = 0; i < m; i++)

{

index >> Index[i];

if (!Index[i])

d = i;

}

index.close();

ifstream matrix("matrix.txt");

for (size\_t i = 0; i < m; i++)

for (size\_t j = 0, i1 = i \* n + j; j < n; j++)

matrix >> a[i1++];

matrix.close();

ifstream X("X.txt");

if (X)

for (size\_t i = 0; i < n; i++)

X >> result[i];

else

for (size\_t i = 0; i < n; i++)

result[i] = 0;

X.close();

ifstream f("F.txt");

for (size\_t i = 0; i < n; i++)

f >> F[i];

f.close();

}

template<class T>

void Matrix<T>::SaveResult()

{

ofstream X("Result.txt");

for (size\_t i = 0; i < n; ++i)

X << result[i];

}

template<class T>

void Matrix<T>::JacobiMethod()

{

if (CheckEnd())

{

Error = 2;

return;

}

for (size\_t i = 0; i < n; i++)

{

#ifdef \_DEBUG

T i1 = RelaxParam(result[i] + (F[i] - f[i]) / matrix(d, i), result[i]), i2 = matrix(d, i), i3 = F[i] - f[i], i4 = result[i] + (F[i] - f[i]) / matrix(d, i), i5 = result[i];

#endif

result[i] = RelaxParam(result[i] + (F[i] - f[i]) / matrix(d, i), result[i]);

}

k++;

}

template<class T>

void Matrix<T>::GaussSeidelMethod()

{

if (CheckEnd())

{

Error = 2;

return;

}

for (size\_t i = 0; i < n; i++)

{

#ifdef \_DEBUG

T i1 = RelaxParam(result[i] + (F[i] - f[i]) / matrix(d, i), result[i]), i2 = matrix(d, i), i3 = F[i] - f[i];

#endif

T res = RelaxParam(result[i] + (F[i] - f[i]) / matrix(d, i), result[i]);

Gaussnewvector(f, res, i);

result[i] = res;

}

k++;

}

//Only 3 deogonal \* 3 format

template<class T>

void Matrix<T>::BlockRelax(int Nblock)

{

vector<matrixA<double>> Fractoriz(n / Nblock + (n % Nblock) / n);

for (size\_t i = 0; i < Fractoriz.size(); i++)

{

matrixA<double> &b = Fractoriz[i];

b.ia.push\_back(0);

for (size\_t j = 0, j2 = Nblock \* i + j; j < n && j < Nblock; j++, j2++)

{

b.di.push\_back(matrix(d, j2));

b.ia.push\_back(j);

}

b.Error = 0;

b.SetN(2);

for (size\_t j = 0, d1 = d - 1, j2 = Nblock \* i + j; j < n && j < Nblock - 1; j++, j2++)

b.al.push\_back(matrix(d1, j2));

for (size\_t j = 1, d2 = d + 1, j2 = Nblock \* i + j; j < n && j < Nblock; j++, j2++)

b.au.push\_back(matrix(d2, j2));

matrixLDU<double> ldu;

ldu.CountLDU(b.al, b.di, b.au, b.ia, TypeMatrix::Prof, b.Error);

}

while (1)

{

if (CheckEnd())

{

Error = 2;

return;

}

for (size\_t i = 0, i1 = 0, i2 = 0; i < Fractoriz.size(); i++)

{

f = MultMatrixAandVector(result);

matrixA<double> &b = Fractoriz[i];

vector<double> wR(0);

for (size\_t k = 0; i1 < n && k < Nblock; k++, i1++)

wR.push\_back((F[i1] - f[i1]) \* w);

matrixLDU<double> ldu;

ldu.SetNErrorM(b.di.size(), b.au.size(), b.Error);

vector<double> newResult(wR.size());

ldu.CountX(b.al, b.di, b.au, wR, newResult, b.ia);

for (size\_t k = 0, k2 = min(n - 1, i2 + Nblock - 1); k < Nblock && i2 < n; k++, i2++)

{

// Blocknewvector(f, newResult[k], i2, k2);

result[i2] += newResult[k];

}

}

k++;

}

}

template<class T>

vector<T> Matrix<T>::Fractorization(int Nblock)

{

vector<T> Fractorization(n \* Nblock);

size\_t deistv = n / Nblock + (n % Nblock) / n;

for (size\_t i = 0, k1 = 0; i < deistv; i++, k1 += Nblock)

{

for (size\_t j = 0; j < Nblock && k1 + j < n; j++)

{

matrixA<T> m;

}

}

}

template<class T>

inline T Matrix<T>::NormVector(vector<T> v)

{

/\*T sum = 0;

for (size\_t i = 0; i < v.size(); i++)

sum += abs(v[i]);

return sum;\*/

/\*T sum = v[0];

for (size\_t i = 1; i < v.size(); i++)

if (sum < v[i])

sum = v[i];

return sum;\*/

return sqrt(inner\_product(v.begin(), v.end(), v.begin(), 0.0));

}

template<class T>

vector<T> Matrix<T>::MultMatrixAandVector(vector<T> X)

{

vector<T> F(n);

for (size\_t i = 0; i < m; i++)

if (Index[i] >= 0)

for (size\_t j = Index[i], j1 = j - Index[i]; j < n; j++)

{

#ifdef \_DEBUG

T i1 = X[j], i2 = matrix(i, j), i3 = F[j - Index[i]];

#endif

F[j1++] += X[j] \* matrix(i, j);

}

else

for (size\_t j = 0, j1 = j - Index[i]; j - Index[i] < n; j++)

{

#ifdef \_DEBUG

T i1 = X[j], i2 = matrix(i, j), i3 = F[j - Index[i]];

#endif

F[j1++] += X[j] \* matrix(i, j);

}

return F;

}

template<class T>

vector<T> Matrix<T>::ResidualVectors(vector<T> a, vector<T> b)

{

vector<T> c(a.size());

for (int i = 0; i < n; i++)

c[i] = a[i] - b[i];

return c;

}

template<class T>

void Matrix<T>::Gaussnewvector(vector<T>& vect, T x, int j)

{

T Res = x - result[j];

for (size\_t i = 0; i < m; i++)

{

int j1 = j - Index[i];

if (j1 > j && j1 < n)

{

#ifdef \_DEBUG

T i1 = vect[j1], i2 = matrix(i, j);

#endif

vect[j1] += Res \* matrix(i, j);

}

}

}

template<class T>

void Matrix<T>::Blocknewvector(vector<T>& vect, T x, int j, int MMAX)

{

T Res = x - result[j];

for (size\_t i = 0; i < m; i++)

{

int j1 = j - Index[i];

if (j1 > MMAX && j1 < n)

{

#ifdef \_DEBUG

T i1 = vect[j1], i2 = matrix(i, j);

#endif

vect[j1] += Res \* matrix(i, j);

}

}

}

template<class T>

inline bool Matrix<T>::CheckEnd()

{

if (k > maxiter)

return true;

f = MultMatrixAandVector(result);

if (NormVector(ResidualVectors(F, f)) / NormVector(F) < e)

{

vector<T> j = MultMatrixAandVector(result), i = ResidualVectors(F, MultMatrixAandVector(result)); T i1 = NormVector(i), i2 = NormVector(F), i3 = i1 / i2;

T sum = 0, sum2 = 0;

for (size\_t i = 0; i < result.size(); i++)

{

sum += pow(i + 1, 2);

sum2 += pow(result[i] - i - 1, 2);

}

T coudA = sqrt(sum2) / sqrt(sum) / i3;

wcout << L"Coud A = " << coudA << endl;

return true;

}

return false;

}

template<class T>

T Matrix<T>::RelaxParam(T x2, T x1)

{

return w \* x2 + (1. - w)\*x1;

}

/\*Source.cpp\*/

#include "includs.h"

#include "Matrix.cpp"

#ifdef \_WIN32

#define CLEAR "cls"

void SetColor(int text, int background)

{

SetConsoleTextAttribute(GetStdHandle(STD\_OUTPUT\_HANDLE), (WORD)((background << 4) | text));

}

#else

#define CLEAR "clear"

#endif

int k;

bool t;

Matrix<double> a;

bool metod;

struct menu

{

public:

static void circle()

{

t = 0;

metod = 0;

do {

system(CLEAR);

picturemenu();

printmenu();

char c = \_getch();

switch (c)

{

case 13:

switch (k)

{

case 0:

{

system(CLEAR);

picturestart();

a.OpenMatrix();

do

{

#ifdef \_DEBUG

wcout << L"k = " << a.k << endl;

wcout << L"\t x = ";

for (size\_t i = 0; i < a.result.size(); i++)

wcout << a.result[i] << " ";

wcout << endl;

#endif

(metod ? a.JacobiMethod() : a.GaussSeidelMethod());

} while (a.GetLastError() != 2);

wcout << "\t w = " << a.w << "\t k = " << a.k << endl;

wcout << setprecision(15);

for (size\_t i = 0; i < a.result.size(); i++)

wcout << L"\t" << fixed << a.result[i] << L" | " << scientific << i + 1 - a.result[i] << endl;

wcout << fixed;

char c1 = \_getch();

while (!c1)

c1 = \_getch();

break;

}

case 1:

k = 0;

do

{

system(CLEAR);

picturesettings();

wcout << endl << L"\te = " << a.e << L"\t w = " << a.w << endl;

wcout << L"\tmetod : " <<( metod ? L"Jacobi method" : L"Gauss–Seidel method" )<< endl;

wcout << L"\tMaxiter = " << a.maxiter << endl << endl;

printsettings();

char c = \_getch();

switch (c)

{

case 13:

switch (k)

{

case 0:

cin >> a.e;

break;

case 1:

cin >> a.w;

break;

case 2:

{

char c1;

char st[100];

cin >> c1;

if(c1 != '0' && c1 != '1')

cin >> st;

if (c1 == 'G' || c1 == '0' || c1 == 'g')

metod = 0;

else

metod = 1;

break;

}

case 3:

cin >> a.maxiter;

break;

case 4:

k = 10;

break;

}

break;

case 72:

k--;

if (k < 0)

k = 0;

break;

case 80:

k++;

if (k > 4)

k = 4;

break;

default:

break;

}

} while (k != 10);

k = 1;

break;

case 2:

system(CLEAR);

pictureexit();

Sleep(5000);

return;

default:

break;

}

break;

case 72:

k--;

if (k < 0)

k = 0;

break;

case 80:

k++;

if (k > 2)

k = 2;

break;

default:

break;

}

} while (1);

}

private:

static void printsettings()

{

printstr(L"\t\t enter e\0", 0);

printstr(L"\t\t enter w\0", 1);

printstr(L"\t\t enter metod\0", 2);

printstr(L"\t\tenter maxiter\0", 3);

printstr(L"\t\t back to menu\0", 4);

}

static void picturemenu()

{

}

static void picturesettings()

{

}

static void pictureexit()

{

}

static void printmenu()

{

printstr(L"\t\t\t start\0", 0);

printstr(L"\t\t\t settings\0", 1);

printstr(L"\t\t\t exit\0", 2);

}

static void picturestart()

{

}

static void printstr(const wchar\_t a[], int number)

{

if (k == number)

{

int i = 0;

#ifdef \_WIN32

SetColor(5, 0);

#endif

while (a[i] == L'\t')

wcout << L'\t', i++;

while (a[i] == L' ')

wcout << L' ', i++;

for (; i < wcslen(a); i++)

{

char c = (int)a[i] - (int)L'a' + (int)L'A';

wcout << c;

}

wcout << endl;

#ifdef \_WIN32

SetColor(15, 0);

#endif

}

else

{

wcout << a << endl;

}

}

};

int wmain(int argc, wchar\_t\* argv[])

{

#ifdef \_WIN32

SetConsoleTitle("Numecal methods Mayer Valera lab #2");

#else

cout << "\033]0;" << "Numecal methods Mayer Valera lab #2" << "\007";

#endif

\_setmode(\_fileno(stdout), \_O\_U16TEXT);

menu::circle();

Matrix<double> a;

return 0;

}