Министерство Образования и Науки РФ

Новосибирский Государственный Технический Университет

Кафедра ПМт

**Лабораторная работа №1**

по дисциплине «Численные методы»

Факультет: ПМИ

Группа: ПМИ-31

Студенты: Савицкий Ю. Р.

Преподаватель: Задорожный А.Г.

Персова М.Г.

Вариант: 4

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1. **Цель работы**

Разработать программу решения СЛАУ прямым методом с хранением матрицы в профильном или ленточном формате. Исследовать накопление погрешности и ее зависимость от числа обусловленности. Сравнить реализованный метод по точности получаемого решения и количеству действий с методом Гаусса.

1. **Задание**

4. *LDU*- разложение, матрица в ленточном формате.

1. **Анализ задачи**

Пусть дана система линейных алгебраических уравнений:



*LDU* разложение является разложением матрицы A в произведение нижнетреугольной матрицы *L*, диагональной матрицы D и верхнетреугольной матрицы U.

Предположим, что нам удалось разложить матрицу:

*A=LDU*

Подставляя (1.2) в (1.1), получаем:

*LDUx=F* (1.3)

Т.к матрица А представима в виде (1.2), то система (1.1) эквивалентна двум системам:

*Ly=F* (1.4) , *Dz=y*(1.5) и *Ux=z*(1.6)

Таким образом, решение системы (1.1) сводится к трем основным этапам:

1) из элементов матрицы  найти элементы матриц L, D, U;

2) решить систему (1.4) с нижнетреугольной матрицей L(прямой ход);

3) решить систему (1.5) с диагональной матрицей D (обратный ход).

4) решить систему (1.6) с верхнетреугольной матрицей U(обратный ход).

Рассмотрим алгоритм получения **- разложения. Матрицы *L, D, U* будем искать в следующем виде:

,.   (1.7)

Учитывая равенство (1.2), перемножим матрицы *L, D, U,* и приравняем к А. Получим следующие формулы для определения элементов:





Очевидно, что не все матрицы  -разложимы (происходит деление на элементы, которым необходимо не быть равными нулю для разложимости матрицы, а также вычисление квадратного корня, который должен быть всегда положителен). Разложение Холецкого всегда существует и единственно для любой симметричной положительно-определённой матрицы.

1. **Текст программы**

* **LDU разложение, обратный/прямой ход, генерация матрицы Гильберта**

**Header.h**

#define \_CRT\_SECURE\_NO\_WARNINGS

#include <stdio.h>

#include <fstream>

#include <io.h>

#include <vector>

#include <iostream>

#include <math.h>

using namespace std;

typedef float chtype;

class Matrix

{

private:

int n, l, middle, k=0;

vector <vector <chtype>> L, U;

vector <chtype> D, F;

public:

void input();

void LDU();

void forD(int, int);

void forLU(int, int, int);

void multyplyL();

void multyplyU();

void multyplyD();

void output();

void vewVector(bool);

void gilbert(int);

};

**Function.cpp**

#include "header.h"

void Matrix::input()

{

FILE \*size, \*di, \*al, \*au, \*f;

int i, j;

chtype buf = 0;

size = fopen("size.txt", "r");

fscanf(size, "%d %d", &n, &l);

fclose(size);

L.resize(n);

U.resize(n);

D.resize(n);

F.resize(n);

middle = l / 2;

if (sizeof(chtype) == sizeof(float))

{

//f

f = fopen("f.txt", "r");

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

fscanf(f, "%f", &F[i]);

fclose(f);

//di

di = fopen("di.txt", "r");

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

fscanf(di, "%f", &D[i]);

fclose(di);

//au

au = fopen("au.txt", "r");

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

{

U[i].resize(middle);

for (j = 0; j < middle; j++)

fscanf(au, "%f", &U[i][j]);

}

fclose(au);

//al

al = fopen("al.txt", "r");

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

{

L[i].resize(middle);

for (j = 0; j < middle; j++)

fscanf(al, "%f", &L[i][j]);

}

fclose(al);

}

else

{

//f

f = fopen("f.txt", "r");

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

fscanf(f, "%lf", &F[i]);

fclose(f);

//di

di = fopen("di.txt", "r");

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

fscanf(di, "%lf", &D[i]);

fclose(di);

//au

au = fopen("au.txt", "r");

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

{

U[i].resize(middle);

for (j = 0; j < middle; j++)

fscanf(au, "%lf", &U[i][j]);

}

fclose(au);

//al

al = fopen("al.txt", "r");

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

{

L[i].resize(middle);

for (j = 0; j < middle; j++)

fscanf(al, "%lf", &L[i][j]);

}

fclose(al);

}

chtype p = 10;

D[0] += pow(p, -k);

F[0] += pow(p, -k);

}

void Matrix::LDU()

{

int i, j, k;

for (k = 0; k < n; k++)

{

i = k;

forD(i, k);

for (j = middle-1, i++; (j >= 0) && (i <n); j--, i++)

{

forLU(i, j, k);

}

}

}

void Matrix::forD(int i, int t)

{

int k = 0, border, b;//b - позиция j элементов в U L

chtype dk, summ = 0;

if (t > 0)

{

if (i <= middle)

{

border = i;

}

else

{

border = middle;

}

for (k = i - border; k < i; k++, border--)

{

b = middle - border;

// l-елементы d-элементы u-элементы

summ += L[i][b] \* D[k] \* U[i][b];

}

}

dk = D[i] - summ;

D[i] = dk;

}

void Matrix::forLU(int i, int j, int t)

{

int k = 0, border = 0, start, b1, b2, b3;//b1 - позиция j для L, b2 - позиция j для U

chtype l=0, u=0, summL = 0, summU=0;

start = i - middle;

if (start < 0)

{

start = 0;

}

b3 = i - middle + j;//строка в U

if (t > 0)

{

k = start;

border = j;

while (border>0)

{

if (L[i][j - border] == 0)

{

border--;

continue;

}// l-елементы d-элементы u-элементы

b1 = j - border; b2 = middle - border;

summL += L[i][b1] \* D[k] \* U[b3][b2];

summU += L[b3][b2] \* D[k] \* U[i][b1];

k++;

border--;

}

}

l = (L[i][j] - summL) / D[b3];

u = (U[i][j] - summU) / D[b3];

U[i][j] = u;

L[i][j] = l;

}

void Matrix::multyplyL()

{

int i = 0, k = 0, j = 0, Max=1, border = 1;

chtype summ=0;

//сначала вычисляются первые Matrix.middle элементов, ибо в матрице происходит смещение начала строки влево

for (i = 1; i <= middle; i++)

{

summ = 0;

for (j = 0; j < Max; j++)

{

k = middle - border + j;

summ += F[j] \* L[i][k];

}

Max++; border++;

F[i] -= summ;

}

//строка матрицы пробегается от начала до конца, но кол-во элементов вектора ограничено Matrix.middle

border = 1;

for (i = middle + 1; i < n; i++)

{

summ = 0;

for (j = 0; j < middle; j++)

{

summ += F[j+border] \* L[i][j];

}

border++;

F[i] -= summ;

}

}

void Matrix::multyplyD()

{

int i = 0;

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

F[i] /= D[i];

}

void Matrix::multyplyU()

{

int k = 0, i = 0, j = 0, Max = n-1, Min=0;

chtype summ = 0;

for (i = n-2; i>= 0; i--)

{

summ = 0;

k = middle - 1;

for (j = i+1; ((j <= Max)&&(k >= 0)); j++, k--)

{

summ += F[j] \* U[j][k];

}

F[i] -= summ;

}

}

void Matrix::output()

{

if (sizeof(chtype) == sizeof(float))

{

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

{

for (int j = 0; j < middle; j++)

printf("%f ", L[i][j]);

printf("%f ", D[i]);

for (int j = 0; j < middle; j++)

printf("%f ", U[i][j]);

printf("\n");

}

}

else

{

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

{

for (int j = 0; j < middle; j++)

printf("%lf ", L[i][j]);

printf("%lf ", D[i]);

for (int j = 0; j < middle; j++)

printf("%lf ", U[i][j]);

printf("\n");

}

}

}

void Matrix::vewVector(bool inFile)

{

if (!inFile)

{

if (sizeof(chtype) == sizeof(float))

{

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

{

printf("%f\n", F[i]);

}

}

else

{

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

{

printf("%lf\n", F[i]);

}

}

}

else

{

FILE \*output;

output = fopen("vector x.txt", "w");

if (sizeof(chtype) == sizeof(float))

{

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

{

fprintf(output, "%f\n", F[i]);

}

}

else

{

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

{

fprintf(output, "%lf\n", F[i]);

}

}

}

}

void Matrix::gilbert(int k)

{

vector <chtype> x;

G.resize(k);

F.resize(k);

x.resize(k);

n = k;

l = k \* 2 - 1;

middle = l / 2;

for (int i = 0; i < k; i++)//заполнение плотной матрицы гильберта

{

G[i].resize(k);

for (int j = 0; j < k; j++)

G[i][j] = (chtype)1 / (i + j + 1);

}

for (int i = 0; i < k; i++)//вектор на который умножаем

{

x[i] = i + 1;

}

for (int i = 0; i < k; i++)//умножение матриц на вектор

{

for (int j = 0; j < k; j++)

F[i] += G[i][j] \* x[j];

}

D.resize(k);

L.resize(k);

U.resize(k);

for (int i = 0; i < k; i++)//преобразование в ленточный формат

{

L[i].resize(k - 1);

U[i].resize(k - 1);

D[i] = G[i][i];

}

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

{

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

{

L[i][abs(i - j - k + 1)] = G[i][j];

U[i][abs(i - j - k + 1)] = G[j][i];

}

}

return;

}

**Main.cpp**

#include "header.h"

void main()

{

Matrix matrix;

matrix.input();

matrix.output();

printf("\n\n\n");

matrix.LDU();

matrix.output();

matrix.multyplyL();

matrix.multyplyD();

matrix.multyplyU();

printf("\n\n\n");

matrix.vewVector(false);

}

* **Метод Гаусса с выбором ведущего элемента**

#define \_CRT\_SECURE\_NO\_WARNINGS

#include <stdio.h>

#include <conio.h>

#include <iostream>

#include <algorithm>

#include <vector>

#define TYPE double

const int n = 10;

using namespace std;

struct matrix

{

vector<vector<TYPE>> A;

vector<TYPE> x;

};

matrix Matr;

void input()

{

FILE \*f = fopen("in.txt", "r");

Matr.A.resize(n);

Matr.x.resize(n);

//Считывание матрицы A и вектора F

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

{

Matr.A[i].resize(n + 1);

for (int j = 0; j < n + 1; j++)

fscanf(f, "%lf", &Matr.A[i][j]);

}

fclose(f);

}

void output()

{

FILE \*f;

//Запись результата в файл

f = fopen("out.txt", "w");

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

{

fprintf(f, "%.16lf ", Matr.x[i]);

fprintf(f, "\n");

}

fclose(f);

}

void gauss()

{

TYPE max, coef, tmp;

int max\_i = 0;

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

{

max = Matr.A[i][i];

max\_i = i;

//Поиск максимального элемента в столбце

for (int j = i + 1; j < n; j++)

(abs(Matr.A[j][i])>max) ? max\_i = j, max = abs(Matr.A[j][i]) : 0;

(max == 0) ? printf("the system has no solutions"): 0;

//Если это не обрабатываемая строка, то меняем строки

if (max\_i != i)

{

//Перестановка в матрице и в векторе

for (int k = i; k < n + 1; k++)

swap(Matr.A[i][k],Matr.A[max\_i][k]);

}

//Преобразование матрицы

for (int j = i + 1; j < n; j++)

{

coef = Matr.A[j][i] / Matr.A[i][i];

Matr.A[j][i] = 0;

if (coef)

for (int k = i + 1; k < n + 1; k++)

Matr.A[j][k] = coef \* Matr.A[i][k] - Matr.A[j][k];

}

}

//Решение СЛАУ

for (int i = n - 1; i >= 0; i--)

{

Matr.x[i] = 0;

tmp = Matr.A[i][n];

for (int j = n - 1; j > i; j--)

tmp -= Matr.A[i][j] \* Matr.x[j];

Matr.x[i] = tmp / Matr.A[i][i];

}

}

void main()

{

input();

gauss();

output();

\_getch();

}

1. **Исследования**

* **Влияние числа обусловленности на точность решения**



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **k** | **xk  (одинарная точность)** | **x\*-xk  (одинарная точность)** | **xk  (двойная точность)** | **x\*-xk (двойная точность)** | **xk (скал.произв.)** | **x\*-xk (скал.произв.)** |
| 0 | 1.00000286 | -1,00E+00 | 0.99999999999999245 | -1,00E+00 | 1,00000489E+00 | -1,00E+00 |
| 2.00000286 | -2,00E+00 | 1.9999999999999911 | -2,00E+00 | 2,00000572E+00 | -2,00E+00 |
| 3.00000334 | -3,00E+00 | 2.9999999999999916 | -3,00E+00 | 3,00000572E+00 | -3,00E+00 |
| 4.00000286 | -4,00E+00 | 3.9999999999999911 | -4,00E+00 | 4,00000525E+00 | -4,00E+00 |
| 5.00000334 | -5,00E+00 | 4.9999999999999911 | -5,00E+00 | 5,00000525E+00 | -5,00E+00 |
| 6.00000286 | -6,00E+00 | 5.9999999999999911 | -6,00E+00 | 6,00000620E+00 | -6,00E+00 |
| 7.00000286 | -7,00E+00 | 6.9999999999999920 | -7,00E+00 | 7,00000525E+00 | -7,00E+00 |
| 8.00000381 | -8,00E+00 | 7.9999999999999902 | -8,00E+00 | 8,00000572E+00 | -8,00E+00 |
| 9.00000286 | -9,00E+00 | 8.9999999999999911 | -9,00E+00 | 9,00000668E+00 | -9,00E+00 |
| 10.0000019 | -1,00E+01 | 9.9999999999999911 | -1,00E+01 | 1,00000057E+01 | -1,00E+01 |
| 1 | 1,0000472 | -1,00E+00 | 0.99999999999968026 | -1,00E+00 | 9,99938910E-01 | -1,00E+00 |
| 2,0000479 | -2,00E+00 | 1.9999999999996758 | -2,00E+00 | 1,99993813E+00 | -2,00E+00 |
| 3,0000477 | -3,00E+00 | 2.9999999999996763 | -3,00E+00 | 2,99993825E+00 | -3,00E+00 |
| 4,0000477 | -4,00E+00 | 3.9999999999996767 | -4,00E+00 | 3,99993801E+00 | -4,00E+00 |
| 5,0000477 | -5,00E+00 | 4.9999999999996767 | -5,00E+00 | 4,99993849E+00 | -5,00E+00 |
| 6,0000482 | -6,00E+00 | 5.9999999999996749 | -6,00E+00 | 5,99993801E+00 | -6,00E+00 |
| 7,0000482 | -7,00E+00 | 6.9999999999996767 | -7,00E+00 | 6,99993849E+00 | -7,00E+00 |
| 8,0000477 | -8,00E+00 | 7.9999999999996749 | -8,00E+00 | 7,99993801E+00 | -8,00E+00 |
| 9,0000477 | -9,00E+00 | 8.9999999999996749 | -9,00E+00 | 8,99993801E+00 | -9,00E+00 |
| 10,0000477 | -1,00E+01 | 9.9999999999996732 | -1,00E+01 | 9,99993801E+00 | -1,00E+01 |
| 2 | 1,0009540 | -1,00E+00 | 1,0000000000035500E+00 | -1,00E+00 | 1,00167155E+00 | -1,00E+00 |
| 2,0009546 | -2,00E+00 | 2,0000000000035600E+00 | -2,00E+00 | 2,00167322E+00 | -2,00E+00 |
| 3,0009546 | -3,00E+00 | 3,0000000000035500E+00 | -3,00E+00 | 3,00167322E+00 | -3,00E+00 |
| 4,0009551 | -4,00E+00 | 4,0000000000035500E+00 | -4,00E+00 | 4,00167322E+00 | -4,00E+00 |
| 5,0009551 | -5,00E+00 | 5,0000000000035500E+00 | -5,00E+00 | 5,00167274E+00 | -5,00E+00 |
| 6,0009546 | -6,00E+00 | 6,0000000000035500E+00 | -6,00E+00 | 6,00167370E+00 | -6,00E+00 |
| 7,0009551 | -7,00E+00 | 7,0000000000035500E+00 | -7,00E+00 | 7,00167370E+00 | -7,00E+00 |
| 8,0009556 | -8,00E+00 | 8,0000000000035600E+00 | -8,00E+00 | 8,00167370E+00 | -8,00E+00 |
| 9,0009556 | -9,00E+00 | 9,0000000000035600E+00 | -9,00E+00 | 9,00167370E+00 | -9,00E+00 |
| 10,0009556 | -1,00E+01 | 1,0000000000003500E+01 | -1,00E+01 | 1,00016737E+01 | -1,00E+01 |
| 3 | 1,0143311 | -1,01E+00 | 1,0000000000319700E+00 | -1,00E+00 | 9,82141730E-01 | -9,82E-01 |
| 2,0143325 | -2,01E+00 | 2,0000000000319700E+00 | -2,00E+00 | 1,98213995E+00 | -1,98E+00 |
| 3,0143328 | -3,01E+00 | 3,0000000000319700E+00 | -3,00E+00 | 2,98214006E+00 | -2,98E+00 |
| 4,0143328 | -4,01E+00 | 4,0000000000319700E+00 | -4,00E+00 | 3,98213983E+00 | -3,98E+00 |
| 5,0143323 | -5,01E+00 | 5,0000000000319800E+00 | -5,00E+00 | 4,98214006E+00 | -4,98E+00 |
| 6,0143337 | -6,01E+00 | 6,0000000000319700E+00 | -6,00E+00 | 5,98213959E+00 | -5,98E+00 |
| 7,0143333 | -7,01E+00 | 7,0000000000319800E+00 | -7,00E+00 | 6,98214006E+00 | -6,98E+00 |
| 8,0143347 | -8,01E+00 | 8,0000000000319800E+00 | -8,00E+00 | 7,98213959E+00 | -7,98E+00 |
| 9,0143328 | -9,01E+00 | 9,0000000000319700E+00 | -9,00E+00 | 8,98213959E+00 | -8,98E+00 |
| 10,0143337 | -1,00E+01 | 1,0000000000031900E+01 | -1,00E+01 | 9,98213959E+00 | -9,98E+00 |
| 4 | 1,5230711 | -1,52E+00 | 1,0000000000710500E+00 | -1,00E+00 | 1,10653615E+00 | -1,11E+00 |
| 2,5230770 | -2,52E+00 | 2,0000000000710500E+00 | -2,00E+00 | 2,10653734E+00 | -2,11E+00 |
| 3,5230763 | -3,52E+00 | 3,0000000000710500E+00 | -3,00E+00 | 3,10653734E+00 | -3,11E+00 |
| 4,5230761 | -4,52E+00 | 4,0000000000710500E+00 | -4,00E+00 | 4,10653734E+00 | -4,11E+00 |
| 5,5230765 | -5,52E+00 | 5,0000000000710500E+00 | -5,00E+00 | 5,10653734E+00 | -5,11E+00 |
| 6,5230775 | -6,52E+00 | 6,0000000000710500E+00 | -6,00E+00 | 6,10653782E+00 | -6,11E+00 |
| 7,5230780 | -7,52E+00 | 7,0000000000710500E+00 | -7,00E+00 | 7,10653782E+00 | -7,11E+00 |
| 8,5230780 | -8,52E+00 | 8,0000000000710500E+00 | -8,00E+00 | 8,10653782E+00 | -8,11E+00 |
| 9,5230789 | -9,52E+00 | 9,0000000000710500E+00 | -9,00E+00 | 9,10653782E+00 | -9,11E+00 |
| 10,5230780 | -1,05E+01 | 1,0000000000071000E+01 | -1,00E+01 | 1,01065378E+01 | -1,01E+01 |
| 5 | 0,6000000 | -6,00E-01 | 9,9999999609201000E-01 | -1,00E+00 | 2,59999776E+00 | -2,60E+00 |
| 1,5999992 | -1,60E+00 | 1,9999999960920000E+00 | -2,00E+00 | 3,59999919E+00 | -3,60E+00 |
| 2,5999992 | -2,60E+00 | 2,9999999960920000E+00 | -3,00E+00 | 4,59999943E+00 | -4,60E+00 |
| 3,5999997 | -3,60E+00 | 3,9999999960920000E+00 | -4,00E+00 | 5,59999895E+00 | -5,60E+00 |
| 4,5999999 | -4,60E+00 | 4,9999999960920000E+00 | -5,00E+00 | 6,59999943E+00 | -6,60E+00 |
| 5,5999985 | -5,60E+00 | 5,9999999960920000E+00 | -6,00E+00 | 7,59999943E+00 | -7,60E+00 |
| 6,6000004 | -6,60E+00 | 6,9999999960920000E+00 | -7,00E+00 | 8,59999943E+00 | -8,60E+00 |
| 7,5999999 | -7,60E+00 | 7,9999999960920000E+00 | -8,00E+00 | 9,59999943E+00 | -9,60E+00 |
| 8,6000004 | -8,60E+00 | 8,9999999960920000E+00 | -9,00E+00 | 1,05999994E+01 | -1,06E+01 |
| 9,5999994 | -9,60E+00 | 9,9999999960920000E+00 | -1,00E+01 | 1,15999994E+01 | -1,16E+01 |
| 6 | 7,0000000 | -7,00E+00 | 1,0000000461852800E+00 | -1,00E+00 | 8,99999905E+00 | -9,00E+00 |
| 8,0000019 | -8,00E+00 | 2,0000000461852800E+00 | -2,00E+00 | 9,99999905E+00 | -1,00E+01 |
| 8,9999991 | -9,00E+00 | 3,0000000461852800E+00 | -3,00E+00 | 1,09999991E+01 | -1,10E+01 |
| 10,0000019 | -1,00E+01 | 4,0000000461852800E+00 | -4,00E+00 | 1,19999991E+01 | -1,20E+01 |
| 11,0000000 | -1,10E+01 | 5,0000000461852800E+00 | -5,00E+00 | 1,29999991E+01 | -1,30E+01 |
| 12,0000019 | -1,20E+01 | 6,0000000461852800E+00 | -6,00E+00 | 1,39999991E+01 | -1,40E+01 |
| 13,0000000 | -1,30E+01 | 7,0000000461852800E+00 | -7,00E+00 | 1,50000000E+01 | -1,50E+01 |
| 14,0000010 | -1,40E+01 | 8,0000000461852800E+00 | -8,00E+00 | 1,60000000E+01 | -1,60E+01 |
| 14,9999991 | -1,50E+01 | 9,0000000461852800E+00 | -9,00E+00 | 1,70000000E+01 | -1,70E+01 |
| 16,0000000 | -1,60E+01 | 1,0000000046185200E+01 | -1,00E+01 | 1,80000000E+01 | -1,80E+01 |
| 7 | 7,0000000 | -7,00E+00 | 1,0000000532907000E+00 | -1,00E+00 | 8,99999905E+00 | -9,00E+00 |
| 8,0000019 | -8,00E+00 | 2,0000000532907000E+00 | -2,00E+00 | 9,99999905E+00 | -1,00E+01 |
| 8,9999991 | -9,00E+00 | 3,0000000532907000E+00 | -3,00E+00 | 1,09999991E+01 | -1,10E+01 |
| 10,0000019 | -1,00E+01 | 4,0000000532907000E+00 | -4,00E+00 | 1,19999991E+01 | -1,20E+01 |
| 11,0000000 | -1,10E+01 | 5,0000000532907000E+00 | -5,00E+00 | 1,29999991E+01 | -1,30E+01 |
| 12,0000019 | -1,20E+01 | 6,0000000532907000E+00 | -6,00E+00 | 1,39999991E+01 | -1,40E+01 |
| 13,0000000 | -1,30E+01 | 7,0000000532907000E+00 | -7,00E+00 | 1,50000000E+01 | -1,50E+01 |
| 14,0000010 | -1,40E+01 | 8,0000000532907000E+00 | -8,00E+00 | 1,60000000E+01 | -1,60E+01 |
| 14,9999991 | -1,50E+01 | 9,0000000532907000E+00 | -9,00E+00 | 1,70000000E+01 | -1,70E+01 |
| 16,0000000 | -1,60E+01 | 1,0000000053290700E+01 | -1,00E+01 | 1,80000000E+01 | -1,80E+01 |
| 8 | 7,0000000 | -7,00E+00 | 1,0000021316280200E+00 | -1,00E+00 | 8,99999905E+00 | -9,00E+00 |
| 8,0000019 | -8,00E+00 | 2,0000021316280200E+00 | -2,00E+00 | 9,99999905E+00 | -1,00E+01 |
| 8,9999991 | -9,00E+00 | 3,0000021316280200E+00 | -3,00E+00 | 1,09999991E+01 | -1,10E+01 |
| 10,0000019 | -1,00E+01 | 4,0000021316280200E+00 | -4,00E+00 | 1,19999991E+01 | -1,20E+01 |
| 11,0000000 | -1,10E+01 | 5,0000021316280200E+00 | -5,00E+00 | 1,29999991E+01 | -1,30E+01 |
| 12,0000019 | -1,20E+01 | 6,0000021316280200E+00 | -6,00E+00 | 1,39999991E+01 | -1,40E+01 |
| 13,0000000 | -1,30E+01 | 7,0000021316280200E+00 | -7,00E+00 | 1,50000000E+01 | -1,50E+01 |
| 14,0000010 | -1,40E+01 | 8,0000021316280300E+00 | -8,00E+00 | 1,60000000E+01 | -1,60E+01 |
| 14,9999991 | -1,50E+01 | 9,0000021316280200E+00 | -9,00E+00 | 1,70000000E+01 | -1,70E+01 |
| |  | | --- | | 16,0000000 | | -1,60E+01 | 1,0000002131628000E+01 | -1,00E+01 | |  | | --- | | 1,80000000E+01 | | -1,80E+01 |
| 9 |  |  | 1,0000284219090200E+00 | -1,00E+00 |  |  |
|  |  | 2,0000284219090200E+00 | -2,00E+00 |  |  |
|  |  | 3,0000284219090200E+00 | -3,00E+00 |  |  |
|  |  | 4,0000284219090200E+00 | -4,00E+00 |  |  |
|  |  | 5,0000284219090200E+00 | -5,00E+00 |  |  |
|  |  | 6,0000284219090200E+00 | -6,00E+00 |  |  |
|  |  | 7,0000284219090200E+00 | -7,00E+00 |  |  |
|  |  | 8,0000284219090200E+00 | -8,00E+00 |  |  |
|  |  | 9,0000284219090200E+00 | -9,00E+00 |  |  |
|  |  | 1,0000028421909000E+01 | -1,00E+01 |  |  |
| 10 |  |  | 9,9959145610373900E-01 | -1,00E+00 |  |  |
|  |  | 1,9995914561037300E+00 | -2,00E+00 |  |  |
|  |  | 2,9995914561037300E+00 | -3,00E+00 |  |  |
|  |  | 3,9995914561037300E+00 | -4,00E+00 |  |  |
|  |  | 4,9995914561037300E+00 | -5,00E+00 |  |  |
|  |  | 5,9995914561037300E+00 | -6,00E+00 |  |  |
|  |  | 6,9995914561037300E+00 | -7,00E+00 |  |  |
|  |  | 7,9995914561037300E+00 | -8,00E+00 |  |  |
|  |  | 8,9995914561037300E+00 | -9,00E+00 |  |  |
|  |  | 9,9995914561037300E+00 | -1,00E+01 |  |  |
| 11 |  |  | 9,9751332149201000E-01 | -9,98E-01 |  |  |
|  |  | 1,9975133214920000E+00 | -2,00E+00 |  |  |
|  |  | 2,9975133214920000E+00 | -3,00E+00 |  |  |
|  |  | 3,9975133214920000E+00 | -4,00E+00 |  |  |
|  |  | 4,9975133214920000E+00 | -5,00E+00 |  |  |
|  |  | 5,9975133214920000E+00 | -6,00E+00 |  |  |
|  |  | 6,9975133214920000E+00 | -7,00E+00 |  |  |
|  |  | 7,9975133214920000E+00 | -8,00E+00 |  |  |
|  |  | 8,9975133214920000E+00 | -9,00E+00 |  |  |
|  |  | 9,9975133214920000E+00 | -1,00E+01 |  |  |
| 12 |  |  | 1,0178890876565200E+00 | -1,02E+00 |  |  |
|  |  | 2,0178890876565300E+00 | -2,02E+00 |  |  |
|  |  | 3,0178890876565300E+00 | -3,02E+00 |  |  |
|  |  | 4,0178890876565200E+00 | -4,02E+00 |  |  |
|  |  | 5,0178890876565300E+00 | -5,02E+00 |  |  |
|  |  | 6,0178890876565300E+00 | -6,02E+00 |  |  |
|  |  | 7,0178890876565300E+00 | -7,02E+00 |  |  |
|  |  | 8,0178890876565200E+00 | -8,02E+00 |  |  |
|  |  | 9,0178890876565300E+00 | -9,02E+00 |  |  |
|  |  | 1,0017889087656500E+01 | -1,00E+01 |  |  |
| 13 |  |  | 1,5490196078431300E+00 | -1,55E+00 |  |  |
|  |  | 2,5490196078431300E+00 | -2,55E+00 |  |  |
|  |  | 3,5490196078431300E+00 | -3,55E+00 |  |  |
|  |  | 4,5490196078431300E+00 | -4,55E+00 |  |  |
|  |  | 5,5490196078431300E+00 | -5,55E+00 |  |  |
|  |  | 6,5490196078431300E+00 | -6,55E+00 |  |  |
|  |  | 7,5490196078431300E+00 | -7,55E+00 |  |  |
|  |  | 8,5490196078431300E+00 | -8,55E+00 |  |  |
|  |  | 9,5490196078431300E+00 | -9,55E+00 |  |  |
|  |  | 1,0549019607843100E+01 | -1,05E+01 |  |  |
| 14 |  |  | -2,7272727272726800E-01 | 2,73E-01 |  |  |
|  |  | 7,2727272727272900E-01 | -7,27E-01 |  |  |
|  |  | 1,7272727272727300E+00 | -1,73E+00 |  |  |
|  |  | 2,7272727272727200E+00 | -2,73E+00 |  |  |
|  |  | 3,7272727272727200E+00 | -3,73E+00 |  |  |
|  |  | 4,7272727272727300E+00 | -4,73E+00 |  |  |
|  |  | 5,7272727272727200E+00 | -5,73E+00 |  |  |
|  |  | 6,7272727272727200E+00 | -6,73E+00 |  |  |
|  |  | 7,7272727272727200E+00 | -7,73E+00 |  |  |
|  |  | 8,7272727272727200E+00 | -8,73E+00 |  |  |
| 15 |  |  | -4,1999999999999900E+00 | 4,20E+00 |  |  |
|  |  | -3,1999999999999900E+00 | 3,20E+00 |  |  |
|  |  | -2,1999999999999900E+00 | 2,20E+00 |  |  |
|  |  | -1,1999999999999900E+00 | 1,20E+00 |  |  |
|  |  | -1,9999999999999900E-01 | 2,00E-01 |  |  |
|  |  | 8,0000000000000000E-01 | -8,00E-01 |  |  |
|  |  | 1,8000000000000000E+00 | -1,80E+00 |  |  |
|  |  | 2,7999999999999900E+00 | -2,80E+00 |  |  |
|  |  | 3,8000000000000000E+00 | -3,80E+00 |  |  |
|  |  | 4,7999999999999900E+00 | -4,80E+00 |  |  |
| 16 |  |  | -4,1999999999999900E+00 | 4,20E+00 |  |  |
|  |  | -3,1999999999999900E+00 | 3,20E+00 |  |  |
|  |  | -2,1999999999999900E+00 | 2,20E+00 |  |  |
|  |  | -1,1999999999999900E+00 | 1,20E+00 |  |  |
|  |  | -1,9999999999999900E-01 | 2,00E-01 |  |  |
|  |  | 8,0000000000000000E-01 | -8,00E-01 |  |  |
|  |  | 1,8000000000000000E+00 | -1,80E+00 |  |  |
|  |  | 2,7999999999999900E+00 | -2,80E+00 |  |  |
|  |  | 3,8000000000000000E+00 | -3,80E+00 |  |  |
|  |  | 4,7999999999999900E+00 | -4,80E+00 |  |  |

* **Исследование на матрицах Гильберта разной размерности**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **k** | **xk  (одинарная точность)** | **x\*-xk  (одинарная точность)** | **xk  (двойная точность)** | **x\*-xk (двойная точность)** | **xk (скал.произв.)** | **x\*-xk (скал.произв.)** |
| 1 | 1,00000000E+00 | 0,00E+00 | 1,0000000000000000E+00 | 0,00E+00 | 1,00000000E+00 | 0,00E+00 |
| 2 | 1,00000048E+00 | -4,80E-07 | 1,0000000000000000E+00 | 0,00E+00 | 1,00000048E+00 | -4,80E-07 |
| 1,99999917E+00 | 8,30E-07 | 1,9999999999999900E+00 | 9,99E-15 | 1,99999917E+00 | 8,30E-07 |
| 3 | 1,00000191E+00 | -1,91E-06 | 1,0000000000000000E+00 | 0,00E+00 | 1,00000024E+00 | 2,40E-07 |
| 1,99998903E+00 | 1,10E-05 | 1,9999999999999600E+00 | 4,00E-14 | 1,99999940E+00 | 6,00E-07 |
| 3,00001049E+00 | -1,05E-05 | 3,0000000000000300E+00 | -3,02E-14 | 3,00000000E+00 | 0,00E+00 |
| 4 | 9,99987600E-01 | 1,24E-05 | 1,0000000000000000E+00 | 0,00E+00 | 9,99982120E-01 | 1,79E-05 |
| 2,00012255E+00 | -1,23E-04 | 1,9999999999999200E+00 | 7,99E-14 | 2,00018406E+00 | -1,84E-04 |
| 2,99972725E+00 | 2,73E-04 | 3,0000000000002700E+00 | -2,70E-13 | 2,99958181E+00 | 4,18E-04 |
| 4,00016737E+00 | -1,67E-04 | 3,9999999999997800E+00 | 2,20E-13 | 4,00026083E+00 | -2,61E-04 |
| 5 | 9,99956610E-01 | 4,34E-05 | 9,9999999999956400E-01 | 4,36E-13 | 1,00002480E+00 | -2,48E-05 |
| 2,00090122E+00 | -9,01E-04 | 2,0000000000079300E+00 | -7,93E-12 | 1,99956620E+00 | 4,34E-04 |
| 2,99592113E+00 | 4,08E-03 | 2,9999999999664800E+00 | 3,35E-11 | 3,00184321E+00 | -1,84E-03 |
| 4,00632095E+00 | -6,32E-03 | 4,0000000000498600E+00 | -4,99E-11 | 3,99721575E+00 | 2,78E-03 |
| 4,99686003E+00 | 3,14E-03 | 4,9999999999758700E+00 | 2,41E-11 | 5,00136900E+00 | -1,37E-03 |
| 6 | 1,00052834E+00 | -5,28E-04 | 1,0000000000034000E+00 | -3,40E-12 | 1,00055516E+00 | -5,55E-04 |
| 1,98907924E+00 | 1,09E-02 | 1,9999999999008100E+00 | 9,92E-11 | 1,98748422E+00 | 1,25E-02 |
| 3,05654645E+00 | -5,65E-02 | 3,0000000006802200E+00 | -6,80E-10 | 3,07048535E+00 | -7,05E-02 |
| 3,88375044E+00 | 1,16E-01 | 3,9999999982133900E+00 | 1,79E-09 | 3,84245276E+00 | 1,58E-01 |
| 5,10346413E+00 | -1,03E-01 | 5,0000000019863400E+00 | -1,99E-09 | 5,15274191E+00 | -1,53E-01 |
| 5,96671343E+00 | 3,33E-02 | 5,9999999992129400E+00 | 7,87E-10 | 5,94627523E+00 | 5,37E-02 |
| 7 | 9,99871250E-01 | 1,29E-04 | 9,9999999995461300E-01 | 4,54E-11 | 1,00601673E+00 | -6,02E-03 |
| 1,99106634E+00 | 8,93E-03 | 2,0000000017806600E+00 | -1,78E-09 | 1,75553370E+00 | 2,44E-01 |
| 3,18223691E+00 | -1,82E-01 | 2,9999999830450700E+00 | 1,70E-08 | 5,38246202E+00 | -2,38E+00 |
| 3,01452231E+00 | 9,85E-01 | 4,0000000653523900E+00 | -6,54E-08 | -5,33504486E+00 | 9,34E+00 |
| 7,19712830E+00 | -2,20E+00 | 4,9999998809738800E+00 | 1,19E-07 | 2,22102814E+01 | -1,72E+01 |
| 3,83420110E+00 | 2,17E+00 | 6,0000001023174900E+00 | -1,02E-07 | -8,93414211E+00 | 1,49E+01 |
| 7,78232050E+00 | -7,82E-01 | 6,9999999665463000E+00 | 3,35E-08 | 1,19195375E+01 | -4,92E+00 |
| 8 | 1,00151730E+00 | -1,52E-03 | 9,9999999996395400E-01 | 3,60E-11 | 0,99727607 | 2,72E-03 |
| 1,93950343E+00 | 6,05E-02 | 2,0000000015034500E+00 | -1,50E-09 | 2,08752012 | -8,75E-02 |
| 3,57463956E+00 | -5,75E-01 | 2,9999999843495000E+00 | 1,57E-08 | 2,42323184 | 5,77E-01 |
| 1,87374508E+00 | 2,13E+00 | 4,0000000685165000E+00 | -6,85E-08 | 4,75118113 | -7,51E-01 |
| 8,43373489E+00 | -3,43E+00 | 4,9999998495202000E+00 | 1,50E-07 | 8,06779861 | -3,07E+00 |
| 3,98000860E+00 | 2,02E+00 | 6,0000001743156800E+00 | -1,74E-07 | -4,22414494 | 1,02E+01 |
| 6,65386677E+00 | 3,46E-01 | 6,9999998985097500E+00 | 1,01E-07 | 17,76201248 | -1,08E+01 |
| 8,54491234E+00 | -5,45E-01 | 8,0000000233117800E+00 | -2,33E-08 | 4,13166857 | 3,87E+00 |
| 9 | 9,89002230E-01 | 1,10E-02 | 9,9999999764252900E-01 | 2,36E-09 |  |  |
| 2,51708770E+00 | -5,17E-01 | 2,0000001629072700E+00 | -1,63E-07 |  |  |
| -2,77995992E+00 | 5,78E+00 | 2,9999972388260900E+00 | 2,76E-06 |  |  |
| 2,93593884E+01 | -2,54E+01 | 4,0000197366473600E+00 | -1,97E-05 |  |  |
| -4,30812950E+01 | 4,81E+01 | 4,9999275245740500E+00 | 7,25E-05 |  |  |
| 3,18230476E+01 | -2,58E+01 | 6,0001481311269100E+00 | -1,48E-04 |  |  |
| 4,41806831E+01 | -3,72E+01 | 6,9998297274491100E+00 | 1,70E-04 |  |  |
| -4,74894676E+01 | 5,55E+01 | 8,0001029279154300E+00 | -1,03E-04 |  |  |
| 2,94870167E+01 | -2,05E+01 | 8,9999745512222200E+00 | 2,54E-05 |  |  |
| 10 |  |  | 1,0000000252335500E+00 | -2,52E-08 |  |  |
|  |  | 1,9999977869020500E+00 | 2,21E-06 |  |  |
|  |  | 3,0000476711514600E+00 | -4,77E-05 |  |  |
|  |  | 3,9995628043247400E+00 | 4,37E-04 |  |  |
|  |  | 5,0021000403331600E+00 | -2,10E-03 |  |  |
|  |  | 5,9941937107416800E+00 | 5,81E-03 |  |  |
|  |  | 7,0095720882693000E+00 | -9,57E-03 |  |  |
|  |  | 7,9907121461023400E+00 | 9,29E-03 |  |  |
|  |  | 9,0048929834635200E+00 | -4,89E-03 |  |  |
|  |  | 9,9989207238676200E+00 | 1,08E-03 |  |  |
| 11 |  |  | 1,0000000384582900E+00 | -3,85E-08 |  |  |
|  |  | 1,9999958816008300E+00 | 4,12E-06 |  |  |
|  |  | 3,0001086788547600E+00 | -1,09E-04 |  |  |
|  |  | 3,9987685722754700E+00 | 1,23E-03 |  |  |
|  |  | 5,0074156924294800E+00 | -7,42E-03 |  |  |
|  |  | 5,9736945974136400E+00 | 2,63E-02 |  |  |
|  |  | 7,0577045715723300E+00 | -5,77E-02 |  |  |
|  |  | 7,9208309685397300E+00 | 7,92E-02 |  |  |
|  |  | 9,0661226578830500E+00 | -6,61E-02 |  |  |
|  |  | 9,9692606799101700E+00 | 3,07E-02 |  |  |
|  |  | 1,1006097689354600E+01 | -6,10E-03 |  |  |
| 12 |  |  | 9,9999987572788200E-01 | 1,24E-07 |  |  |
|  |  | 2,0000170402690800E+00 | -1,70E-05 |  |  |
|  |  | 2,9994312155305000E+00 | 5,69E-04 |  |  |
|  |  | 4,0081201035020100E+00 | -8,12E-03 |  |  |
|  |  | 4,9381915597593500E+00 | 6,18E-02 |  |  |
|  |  | 6,2801053271636600E+00 | -2,80E-01 |  |  |
|  |  | 6,1990809147067700E+00 | 8,01E-01 |  |  |
|  |  | 9,4819970079625200E+00 | -1,48E+00 |  |  |
|  |  | 7,2293983206041100E+00 | 1,77E+00 |  |  |
|  |  | 1,1318213644101300E+01 | -1,32E+00 |  |  |
|  |  | 1,0443983440316800E+01 | 5,56E-01 |  |  |
|  |  | 1,2101461699473400E+01 | -1,01E-01 |  |  |

* **Сравнение с методом Гаусса**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **k** | **xk  (LLT)** | **x\*-xk** | **xk (Gauss)** | **x\*-xk** |
| 0 | 0,9999999999999780 | 2,20E-14 | 1,0000000000000700 | -6,99E-14 |
| 1,9999999999999700 | 3,00E-14 | 2,0000000000000800 | -7,99E-14 |
| 2,9999999999999700 | 3,02E-14 | 3,0000000000000800 | -7,99E-14 |
| 3,9999999999999700 | 3,02E-14 | 4,0000000000000800 | -7,99E-14 |
| 4,9999999999999700 | 3,02E-14 | 5,0000000000000800 | -7,99E-14 |
| 5,9999999999999700 | 3,02E-14 | 6,0000000000000800 | -7,99E-14 |
| 6,9999999999999700 | 3,02E-14 | 7,0000000000000800 | -7,99E-14 |
| 7,9999999999999700 | 3,02E-14 | 8,0000000000000800 | -7,99E-14 |
| 8,9999999999999700 | 3,02E-14 | 9,0000000000000800 | -7,99E-14 |
| 9,9999999999999700 | 3,02E-14 | 10,0000000000000000 | 0,00E+00 |
| 1 | 0,9999999999999490 | 5,10E-14 | 0,9999999999993560 | 6,44E-13 |
| 1,9999999999999400 | 6,00E-14 | 1,9999999999993400 | 6,60E-13 |
| 2,9999999999999400 | 6,00E-14 | 2,9999999999993500 | 6,50E-13 |
| 3,9999999999999400 | 6,00E-14 | 3,9999999999993400 | 6,60E-13 |
| 4,9999999999999400 | 6,04E-14 | 4,9999999999993400 | 6,60E-13 |
| 5,9999999999999400 | 6,04E-14 | 5,9999999999993400 | 6,60E-13 |
| 6,9999999999999400 | 6,04E-14 | 6,9999999999993400 | 6,60E-13 |
| 7,9999999999999400 | 6,04E-14 | 7,9999999999993400 | 6,60E-13 |
| 8,9999999999999400 | 6,04E-14 | 8,9999999999993400 | 6,61E-13 |
| 9,9999999999999400 | 6,04E-14 | 9,9999999999993400 | 6,61E-13 |
| 2 | 1,0000000000035500 | -3,55E-12 | 0,9999999999955440 | 4,46E-12 |
| 2,0000000000035600 | -3,56E-12 | 1,9999999999955400 | 4,46E-12 |
| 3,0000000000035500 | -3,55E-12 | 2,9999999999955400 | 4,46E-12 |
| 4,0000000000035500 | -3,55E-12 | 3,9999999999955300 | 4,47E-12 |
| 5,0000000000035500 | -3,55E-12 | 4,9999999999955400 | 4,46E-12 |
| 6,0000000000035500 | -3,55E-12 | 5,9999999999955400 | 4,46E-12 |
| 7,0000000000035500 | -3,55E-12 | 6,9999999999955400 | 4,46E-12 |
| 8,0000000000035600 | -3,56E-12 | 7,9999999999955400 | 4,46E-12 |
| 9,0000000000035600 | -3,56E-12 | 8,9999999999955400 | 4,46E-12 |
| 10,0000000000035000 | -3,50E-12 | 9,9999999999955400 | 4,46E-12 |
| 3 | 1,0000000000319700 | -3,20E-11 | 1,0000000000390800 | -3,91E-11 |
| 2,0000000000319700 | -3,20E-11 | 2,0000000000390800 | -3,91E-11 |
| 3,0000000000319700 | -3,20E-11 | 3,0000000000390800 | -3,91E-11 |
| 4,0000000000319700 | -3,20E-11 | 4,0000000000390900 | -3,91E-11 |
| 5,0000000000319800 | -3,20E-11 | 5,0000000000390800 | -3,91E-11 |
| 6,0000000000319700 | -3,20E-11 | 6,0000000000390800 | -3,91E-11 |
| 7,0000000000319800 | -3,20E-11 | 7,0000000000390800 | -3,91E-11 |
| 8,0000000000319800 | -3,20E-11 | 8,0000000000390800 | -3,91E-11 |
| 9,0000000000319700 | -3,20E-11 | 9,0000000000390900 | -3,91E-11 |
| 10,0000000000319000 | -3,19E-11 | 10,0000000000390000 | -3,90E-11 |
| 4 | 1,0000000000710500 | -7,11E-11 | 0,9999999995559030 | 4,44E-10 |
| 2,0000000000710500 | -7,10E-11 | 1,9999999995559000 | 4,44E-10 |
| 3,0000000000710500 | -7,10E-11 | 2,9999999995558900 | 4,44E-10 |
| 4,0000000000710500 | -7,10E-11 | 3,9999999995558900 | 4,44E-10 |
| 5,0000000000710500 | -7,10E-11 | 4,9999999995558900 | 4,44E-10 |
| 6,0000000000710500 | -7,10E-11 | 5,9999999995559000 | 4,44E-10 |
| 7,0000000000710500 | -7,10E-11 | 6,9999999995559000 | 4,44E-10 |
| 8,0000000000710500 | -7,11E-11 | 7,9999999995558900 | 4,44E-10 |
| 9,0000000000710500 | -7,11E-11 | 8,9999999995559000 | 4,44E-10 |
| 10,0000000000710000 | -7,10E-11 | 9,9999999995559000 | 4,44E-10 |
| 5 | 0,9999999960920100 | 3,91E-09 | 0,9999999934274650 | 6,57E-09 |
| 1,9999999960920000 | 3,91E-09 | 1,9999999934274600 | 6,57E-09 |
| 2,9999999960920000 | 3,91E-09 | 2,9999999934274600 | 6,57E-09 |
| 3,9999999960920000 | 3,91E-09 | 3,9999999934274500 | 6,57E-09 |
| 4,9999999960920000 | 3,91E-09 | 4,9999999934274600 | 6,57E-09 |
| 5,9999999960920000 | 3,91E-09 | 5,9999999934274600 | 6,57E-09 |
| 6,9999999960920000 | 3,91E-09 | 6,9999999934274500 | 6,57E-09 |
| 7,9999999960920000 | 3,91E-09 | 7,9999999934274600 | 6,57E-09 |
| 8,9999999960920000 | 3,91E-09 | 8,9999999934274600 | 6,57E-09 |
| 9,9999999960920000 | 3,91E-09 | 9,9999999934274600 | 6,57E-09 |
| 6 | 1,0000000461852800 | -4,62E-08 | 1,0000000532907100 | -5,33E-08 |
| 2,0000000461852800 | -4,62E-08 | 2,0000000532907100 | -5,33E-08 |
| 3,0000000461852800 | -4,62E-08 | 3,0000000532907100 | -5,33E-08 |
| 4,0000000461852800 | -4,62E-08 | 4,0000000532907100 | -5,33E-08 |
| 5,0000000461852800 | -4,62E-08 | 5,0000000532907100 | -5,33E-08 |
| 6,0000000461852800 | -4,62E-08 | 6,0000000532907100 | -5,33E-08 |
| 7,0000000461852800 | -4,62E-08 | 7,0000000532907100 | -5,33E-08 |
| 8,0000000461852800 | -4,62E-08 | 8,0000000532907100 | -5,33E-08 |
| 9,0000000461852800 | -4,62E-08 | 9,0000000532907100 | -5,33E-08 |
| 10,0000000461852000 | -4,62E-08 | 10,0000000532907000 | -5,33E-08 |
| 7 | 1,0000000532907000 | -5,33E-08 | 0,9999982946977730 | 1,71E-06 |
| 2,0000000532907000 | -5,33E-08 | 1,9999982946977500 | 1,71E-06 |
| 3,0000000532907000 | -5,33E-08 | 2,9999982946977600 | 1,71E-06 |
| 4,0000000532907000 | -5,33E-08 | 3,9999982946977400 | 1,71E-06 |
| 5,0000000532907000 | -5,33E-08 | 4,9999982946977600 | 1,71E-06 |
| 6,0000000532907000 | -5,33E-08 | 5,9999982946977500 | 1,71E-06 |
| 7,0000000532907000 | -5,33E-08 | 6,9999982946977500 | 1,71E-06 |
| 8,0000000532907000 | -5,33E-08 | 7,9999982946977500 | 1,71E-06 |
| 9,0000000532907000 | -5,33E-08 | 8,9999982946977500 | 1,71E-06 |
| 10,0000000532907000 | -5,33E-08 | 9,9999982946977500 | 1,71E-06 |
| 8 | 1,0000021316280200 | -2,13E-06 | 1,0000092370662700 | -9,24E-06 |
| 2,0000021316280200 | -2,13E-06 | 2,0000092370662800 | -9,24E-06 |
| 3,0000021316280200 | -2,13E-06 | 3,0000092370662800 | -9,24E-06 |
| 4,0000021316280200 | -2,13E-06 | 4,0000092370662900 | -9,24E-06 |
| 5,0000021316280200 | -2,13E-06 | 5,0000092370662800 | -9,24E-06 |
| 6,0000021316280200 | -2,13E-06 | 6,0000092370662800 | -9,24E-06 |
| 7,0000021316280200 | -2,13E-06 | 7,0000092370662800 | -9,24E-06 |
| 8,0000021316280300 | -2,13E-06 | 8,0000092370662800 | -9,24E-06 |
| 9,0000021316280200 | -2,13E-06 | 9,0000092370662800 | -9,24E-06 |
| 10,0000021316280000 | -2,13E-06 | 10,0000092370662000 | -9,24E-06 |
| 9 | 1,0000284219090200 | -2,84E-05 | 1,0000603966639600 | -6,04E-05 |
| 2,0000284219090200 | -2,84E-05 | 2,0000603966639700 | -6,04E-05 |
| 3,0000284219090200 | -2,84E-05 | 3,0000603966639700 | -6,04E-05 |
| 4,0000284219090200 | -2,84E-05 | 4,0000603966639700 | -6,04E-05 |
| 5,0000284219090200 | -2,84E-05 | 5,0000603966639700 | -6,04E-05 |
| 6,0000284219090200 | -2,84E-05 | 6,0000603966639700 | -6,04E-05 |
| 7,0000284219090200 | -2,84E-05 | 7,0000603966639700 | -6,04E-05 |
| 8,0000284219090200 | -2,84E-05 | 8,0000603966639700 | -6,04E-05 |
| 9,0000284219090200 | -2,84E-05 | 9,0000603966639700 | -6,04E-05 |
| 10,0000284219090000 | -2,84E-05 | 10,0000603966639000 | -6,04E-05 |
| 10 | 0,9995914561037390 | 4,09E-04 | 0,9994848748601240 | 5,15E-04 |
| 1,9995914561037300 | 4,09E-04 | 1,9994848748601200 | 5,15E-04 |
| 2,9995914561037300 | 4,09E-04 | 2,9994848748601100 | 5,15E-04 |
| 3,9995914561037300 | 4,09E-04 | 3,9994848748601100 | 5,15E-04 |
| 4,9995914561037300 | 4,09E-04 | 4,9994848748601100 | 5,15E-04 |
| 5,9995914561037300 | 4,09E-04 | 5,9994848748601100 | 5,15E-04 |
| 6,9995914561037300 | 4,09E-04 | 6,9994848748601100 | 5,15E-04 |
| 7,9995914561037300 | 4,09E-04 | 7,9994848748601100 | 5,15E-04 |
| 8,9995914561037300 | 4,09E-04 | 8,9994848748601100 | 5,15E-04 |
| 9,9995914561037300 | 4,09E-04 | 9,9994848748601100 | 5,15E-04 |
| 11 | 0,9975133214920100 | 2,49E-03 | 1,0039097209880900 | -3,91E-03 |
| 1,9975133214920000 | 2,49E-03 | 2,0039097209880900 | -3,91E-03 |
| 2,9975133214920000 | 2,49E-03 | 3,0039097209880900 | -3,91E-03 |
| 3,9975133214920000 | 2,49E-03 | 4,0039097209880900 | -3,91E-03 |
| 4,9975133214920000 | 2,49E-03 | 5,0039097209880900 | -3,91E-03 |
| 5,9975133214920000 | 2,49E-03 | 6,0039097209880900 | -3,91E-03 |
| 6,9975133214920000 | 2,49E-03 | 7,0039097209880900 | -3,91E-03 |
| 7,9975133214920000 | 2,49E-03 | 8,0039097209880900 | -3,91E-03 |
| 8,9975133214920000 | 2,49E-03 | 9,0039097209880900 | -3,91E-03 |
| 9,9975133214920000 | 2,49E-03 | 10,0039097209880000 | -3,91E-03 |
| 12 | 1,0178890876565200 | -1,79E-02 | 0,9946428571428540 | 5,36E-03 |
| 2,0178890876565300 | -1,79E-02 | 1,9946428571428500 | 5,36E-03 |
| 3,0178890876565300 | -1,79E-02 | 2,9946428571428500 | 5,36E-03 |
| 4,0178890876565200 | -1,79E-02 | 3,9946428571428400 | 5,36E-03 |
| 5,0178890876565300 | -1,79E-02 | 4,9946428571428500 | 5,36E-03 |
| 6,0178890876565300 | -1,79E-02 | 5,9946428571428500 | 5,36E-03 |
| 7,0178890876565300 | -1,79E-02 | 6,9946428571428500 | 5,36E-03 |
| 8,0178890876565200 | -1,79E-02 | 7,9946428571428500 | 5,36E-03 |
| 9,0178890876565300 | -1,79E-02 | 8,9946428571428500 | 5,36E-03 |
| 10,0178890876565000 | -1,79E-02 | 9,9946428571428500 | 5,36E-03 |
| 13 | 1,5490196078431300 | -5,49E-01 | 1,6530612244897900 | -6,53E-01 |
| 2,5490196078431300 | -5,49E-01 | 2,6530612244898000 | -6,53E-01 |
| 3,5490196078431300 | -5,49E-01 | 3,6530612244898000 | -6,53E-01 |
| 4,5490196078431300 | -5,49E-01 | 4,6530612244898000 | -6,53E-01 |
| 5,5490196078431300 | -5,49E-01 | 5,6530612244898000 | -6,53E-01 |
| 6,5490196078431300 | -5,49E-01 | 6,6530612244898000 | -6,53E-01 |
| 7,5490196078431300 | -5,49E-01 | 7,6530612244898000 | -6,53E-01 |
| 8,5490196078431300 | -5,49E-01 | 8,6530612244898000 | -6,53E-01 |
| 9,5490196078431300 | -5,49E-01 | 9,6530612244898000 | -6,53E-01 |
| 10,5490196078431000 | -5,49E-01 | 10,6530612244897000 | -6,53E-01 |
| 14 | -0,2727272727272680 | 1,27E+00 | 6,0000000000000000 | -5,00E+00 |
| 0,7272727272727290 | 1,27E+00 | 7,0000000000000000 | -5,00E+00 |
| 1,7272727272727300 | 1,27E+00 | 8,0000000000000000 | -5,00E+00 |
| 2,7272727272727200 | 1,27E+00 | 9,0000000000000100 | -5,00E+00 |
| 3,7272727272727200 | 1,27E+00 | 10,0000000000000000 | -5,00E+00 |
| 4,7272727272727300 | 1,27E+00 | 11,0000000000000000 | -5,00E+00 |
| 5,7272727272727200 | 1,27E+00 | 11,9999999999999000 | -5,00E+00 |
| 6,7272727272727200 | 1,27E+00 | 13,0000000000000000 | -5,00E+00 |
| 7,7272727272727200 | 1,27E+00 | 13,9999999999999000 | -5,00E+00 |
| 8,7272727272727200 | 1,27E+00 | 15,0000000000000000 | -5,00E+00 |
| 15 | -4,1999999999999900 | 5,20E+00 | -6,6666666666666600 | 7,67E+00 |
| -3,1999999999999900 | 5,20E+00 | -5,6666666666666600 | 7,67E+00 |
| -2,1999999999999900 | 5,20E+00 | -4,6666666666666600 | 7,67E+00 |
| -1,1999999999999900 | 5,20E+00 | -3,6666666666666600 | 7,67E+00 |
| -0,1999999999999990 | 5,20E+00 | -2,6666666666666600 | 7,67E+00 |
| 0,8000000000000000 | 5,20E+00 | -1,6666666666666600 | 7,67E+00 |
| 1,8000000000000000 | 5,20E+00 | -0,6666666666666660 | 7,67E+00 |
| 2,7999999999999900 | 5,20E+00 | 0,3333333333333340 | 7,67E+00 |
| 3,8000000000000000 | 5,20E+00 | 1,3333333333333300 | 7,67E+00 |
| 4,7999999999999900 | 5,20E+00 | 2,3333333333333300 | 7,67E+00 |

По таблице видно, что на данных тестах погрешность прямого метода, основанного на -разложении одного порядка с погрешностью метода Гаусса с выбором ведущего элемента. На всех проведённых тестах она меньше, чем у метода Гаусса