



**Escola Tècnica Superior d'Enginyeries
Industrial i Aeronàutica de Terrassa**

UNIVERSITAT POLITÈCNICA DE CATALUNYA

Study of the development and verification of an integrated code for UAV design

Autor: Lluís Armengol Garcia

Director: Pau Nualart Nieto

Provisional delivery: 29th of May, 2015

Final delivery: 12th of June, 2015

Grau en Enginyeria en Tecnologies Aeroespacials

Table of content

<i>ANNEX 1</i>	<i>2</i>
<i>2D analysis C++ code</i>	<i>3</i>
<i>ANNEX 2</i>	<i>8</i>
<i>3D analysis C++ code</i>	<i>9</i>
<i>ANNEX 3</i>	<i>24</i>
<i>Wing aerodynamics characteristics.....</i>	<i>25</i>
<i>ANNEX 4</i>	<i>26</i>
<i>3 Generation Analysis. Best population:.....</i>	<i>27</i>
<i>6 Generation Analysis. Best population:.....</i>	<i>27</i>
<i>12 Generation Analysis. Best population:.....</i>	<i>27</i>
<i>24 Generation Analysis. Best population:.....</i>	<i>27</i>
<i>ANNEX 5</i>	<i>28</i>
<i>3 Generations analysis. All population</i>	<i>29</i>
<i>6 Generations analysis. All population</i>	<i>32</i>
<i>12 Generations analysis. All population</i>	<i>37</i>
<i>24 Generations analysis. All population</i>	<i>46</i>

ANNEX 1

```

2D analysis C++ code

#include <iostream>
#include <fstream>
#include <string>
#include <vector>
#include <stdlib.h>
#include <cmath>

using namespace std;
int main(void){

    //definició de les variables:

    int NACA, num_cl, num_cdp, num_cdf, cont=0, a;
    int Re_min, Re_max, Re_inc, alpha_min, alpha_max, alpha_inc, i, j, alpha;
    double cl_max, maxim;
    vector<double> cdf(1000000), cdp(1000000), aoa(1000000),
    coef_2D(100000000);
    string file_polar, file_path, path_polar, file_clmax, path_clmaxim, file_cd,
    path_cds, qq, tt, rr, dd;
    bool max = true;

    //Introducció dades usuari:

    NACA=4415; //perfil
    Re_min=4000000; //reynolds mínim
    Re_max=6000000; //reynolds màxim
    Re_inc=10000; //increment de Reynolds
    alpha_min=0; //angle d'atac inicial
    alpha_max=20; //angle d'atac final
    alpha_inc=1; //increment angle d'atac

    //Es calculen els coeficients per a cada Reynolds
    for(i=Re_min; i<=Re_max; i=i+Re_inc){

        //Arxiu de comandes. Són les entrades al XFOIL:

```

```

        ofstream comandes_XFoil("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/Comandes/comandes_Xfoil.txt");

        comandes_XFoil <<"NACA "<<NACA<< endl;
        comandes_XFoil <<"oper"<< endl;
        comandes_XFoil <<"visc"<< endl;
        comandes_XFoil <<i<<endl;
        comandes_XFoil <<"pacc"<< endl;

        comandes_XFoil <<"C:\\Users\\Lluis
Armengol\\Desktop\\TFG\\PV2\\2D\\<<i<<.txt"<< endl << endl;
        comandes_XFoil <<"aseq"<< endl;
        comandes_XFoil <<alpha_min<< endl;
        comandes_XFoil <<alpha_max<< endl;
        comandes_XFoil <<alpha_inc<< endl << endl;
        comandes_XFoil <<"QUIT"<< endl;
        comandes_XFoil.close();

//Executo Xfoil i es creen les polars per a cada valor de reynolds:

system("xfoil.exe<"C:\\Users\\Lluis
Armengol\\Desktop\\TFG\\PV2\\Comandes\\comandes_Xfoil.txt");

} //end for

for(i=Re_min; i<=(Re_max); i=i+Re_inc){

    maxim=0;

    //system("PAUSE");

//llegeix l'arxiu dels coeficients aerodinàmics

remove("C:/Users/Lluis Armengol/Desktop/TFG/PV2/2D/path.txt");

        ofstream path_nom("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path.txt");

        path_nom <<i<<.txt"<<endl;
        path_nom.close();

remove("C:/Users/Lluis Armengol/Desktop/TFG/PV2/2D/path_clmax.txt");

        ofstream path_cl("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_clmax.txt");

        path_cl <<i<<"_clmax.txt"<<endl;
        path_cl.close();

```

```

remove("C:/Users/Lluis Armengol/Desktop/TFG/PV2/2D/path_cd.txt");

ofstream path_cd("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_cd.txt");

path_cd <<i<<"_cd.txt"<<endl;
path_cd.close();

ifstream file1("C:/Users/Lluis Armengol/Desktop/TFG/PV2/2D/path.txt");

if(file1.is_open()){

    while(file1>>tt){

        file1 >> tt;
    }
}

ifstream file2("C:/Users/Lluis Armengol/Desktop/TFG/PV2/2D/path_clmax.txt");

if(file2.is_open()){

    while(file2>>rr){

        file2 >> rr;
    }
}

ifstream file3("C:/Users/Lluis Armengol/Desktop/TFG/PV2/2D/path_cd.txt");

if(file3.is_open()){

    while(file3>>dd){

        file3 >> dd;
    }
}

file_path ="C:/Users/Lluis Armengol/Desktop/TFG/PV2/2D/";

file_polar =tt;
file_clmax =rr;
file_cd =dd;
path_polar = file_path + file_polar;
path_clmaxim = file_path + file_clmax;
path_cds = file_path + file_cd;

j=0;

ifstream file(path_polar.c_str());

if(file.is_open()){


```

```

file >> qq;
cont=0;

while (file >> qq){

    coef_2D[j]=strtod(qq.c_str(), NULL);

    j=j+1;

    cont=cont + 1;

}

}

a=0;

for(j=47; j<cont; j=j+7){

    if(coef_2D[j] > maxim){

        maxim = coef_2D[j];}

        cdf[a] = coef_2D[j+1];

        cdp[a] = coef_2D[j+2];

        aoa[a] = coef_2D[j-1];

        ofstream cds(path_cds.c_str(), ofstream::app);

        cds << aoa[a] <<      "<< cdf[a] <<"      "<<

cdp[a] << endl;

        cds.close();

        a=a+1;

    }

remove(path_clmaxim.c_str());

        ofstream clmaxim(path_clmaxim.c_str());

        clmaxim << maxim << endl;

        clmaxim.close();

} //end for

//system("PAUSE");

return 0;

}

```


ANNEX 2

3D analysis C++ code

```
#include <iostream>
#include <fstream>
#include <string>
#include <vector>
#include <stdlib.h>
#include <cmath>
#include <iomanip>
using namespace std;
int main(void) {
    //introduccio de dades inicials per definir la geometria de l'ala:
    double b0, b1, b2, b3, c0, c1, c2, c3, S, g, rho, mu, m, M, reynolds=10000,
    comp_re, clmax_Re1, clmax_Re2, abc, MTOW, f, ff=0.02, ffff=1;
    int i, n_perf=2, N=1000, alpha=0, NACA, z, zz, alpha_CLmax, alpha_final, j, p1,
    p2, aa, bb;
    string myArray[1000], myArray_TOT[1000], cd_Re1[100], cd_Re2[100],
    dades_Re1, dades_Re2;
    string filename_Re1, filename_Re1_cd, filename_Re2, filename_Re2_cd,
    filename_polar, path_polar;
    string path_polar_TOT, path, path_file_1, path_file_2, path_file_3, path_file_4, tt, rr,
    dd1, dd2, mtw;
    double CL_TOT, CD_TOT;
    double CL[N][n_perf], V[N][n_perf], Vinf[N], Re[N][n_perf], clmax[N][n_perf],
    Re_1[N][n_perf], Re_2[N][n_perf], y[n_perf], Ab[n_perf];
    double cdf1[n_perf], cdf2[n_perf], cdf[n_perf], cdp1[n_perf], cdp2[n_perf], cdp[n_perf],
    cdfm[n_perf], cdpm[n_perf];
    double CDfsum[N], CDpsum[N], CDf[N], CDp[N];
    bool reyn, a3D = true, MTOW_OK=true;
    //-----
    //Dades generals:
    ifstream inputs("C:/Users/Lluis Armengol/Desktop/TFG/PV2/Eval.DVs");
    if(inputs.is_open()) {
        for(int i = 0; i < 2; i++){
            if(i == 0){
```

```

    if(i==0){
        inputs>>b1;
    }

    if(i==1){
        inputs>>c0;
    }

    if(i==2){
        inputs>>c1;
    }

}

b0=0;           // tram central de l'envergadura [m]
//b1=1.5;       // tram final de l'envergadura [m]
b2=2*b1;       // envergadura total [m]
//c0=0.4;       // corda del tram central [m]
//c1=0.3;       // corda del tram final [m]
c2=(c0+c1)/2; // corda mitja [m]
S=c1*b1*2+(c0-c1)*b1; // Superficie [m^2]
g=9.8;          // gravetat [m/s^2]
rho=1.225;      // densitat de l'aire [kg/m^3]
mu=1.5e-5;      // [viscositat cinemàtica]
M=2;            // MTOW [kg]
NACA = 4415;    //perfil NACA

//-----
//pendent de la recta per definir els trams on calcularem els perfils:
m=(c0-c1)/b1;
//dividim l'ala en trams:
double c[n_perf];
for (i=0; i<n_perf; i++) {

```

```

        if(i==0) {
            c[0]=c0;
        } else if(i==(n_perf-1)) {
            c[i]=c1;
        } else {
            c[i]=c0-m*(b1/n_perf)*i;
        }
    }

//-----
//crear arxiu .txt amb el format AVL:

ofstream fs("ALA.avl");
fs <<"Wing ALA"<< endl;
fs <<"#Mach"<< endl;
fs <<" 0.0"<< endl;
fs <<"#IYsym  IZsym  Zsym"<< endl;
fs <<" 0      0      0.0"<< endl;
fs <<"#Sref   Cref   Bref"<< endl;
fs <<S<<"    "<<c2<<"    "<<b2<< endl;
fs <<"#Xref   Yref   Zref"<< endl;
fs <<"0.50    0.0    0.0"<< endl;
fs <<"#"<<endl<<"#"<< endl;
fs
<<"#=====
===== "<< endl;

fs <<"SURFACE"<< endl;
fs <<"Wing"<< endl;
fs <<"#Nchordwise  Cspace  Nspanwise  Sspace"<< endl;
fs <<"12          1.0      "<<n_perf<<"          1.0"<< endl;
fs <<"#"<< endl;
fs <<"YDUPLICATE"<< endl;
fs <<"0.0"<< endl;

```

```

fs <<"#"<< endl;
fs <<"ANGLE"<< endl;
fs <<"0.0"<< endl;
fs <<"#-----"<< endl;
fs <<"SECTION"<< endl;
fs <<"#Xle Yle Zle Chord Ainc Nspanwise Sspace"<< endl;
fs <<"0.    "<<b0<<" 0.    "<<c0<<" 0.0  0      0"<< endl << endl;
fs <<"NACA"<< endl;
fs <<NACA<< endl << endl;
fs <<"#-----"<< endl;
fs <<"SECTION"<< endl;
fs <<"#Xle Yle Zle Chord Ainc Nspanwise Sspace"<< endl;
fs <<"0.4    "<<b1<<" 0.1    "<<c1<<" 0.0  0      0"<< endl << endl;
fs <<"NACA"<< endl;
fs <<NACA<< endl << endl;
fs <<"#"<< endl;
fs.close();
//-----
while(MTOW_OK){
    aa=1;
    bb=2;
    while(a3D) {
//Creo arxiu de comandes:
        remove("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/3D/forces_span2.txt");
        ofstream a("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/Comandes/comandes_avl.txt");
        a <<"load"<<endl;
        a <<"ALA.avl"<<endl;
        a <<"oper"<<endl;
        a <<"A"<<endl;
    }
}

```

```

a <<"A"<<endl;
a <<alpha<<endl;
a <<"M"<<endl;
a <<"M"<<endl;
a <<M<<endl;
a <<"D"<<endl;
a <<"1.225"<<endl;
a <<"G"<<endl;
a <<g<<endl<<endl;
a <<"X"<<endl;
a <<"FS"<<endl;

a <<"C:\\Users\\Lluis
Armengol\\Desktop\\TFG\\PV2\\3D\\forces_span2.txt"<<endl<<endl;
a <<"QUIT"<<endl;
a.close();

```

//Fer l'anàlisis de l'ala per un angles d'atac (alpha). Es crea un arxiu on es guarden els coeficients en funció de l'envergadura

```

//executa AVL.exe

system("avl.exe<"C:/Users/Lluis
Armengol/Desktop/TFG/PV2/Comandes/comandes_avl.txt");

//-----
//Llegir l'arxiu de forces aerodinàmiques creat amb l'AVL

//Ilegeix l'arxiu de les forces i coeficients aerodinàmics "forces_span.txt"

ifstream file("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/3D/forces_span2.txt");

if(file.is_open()) {

    for(int i = 0; i < 900; i++) {

        file >> myArray[i];
    }
}

//Crea dues matrius on emmagatzema els CL i CD en funció de l'angle i
de l'envergadura:

z=118; //posició del valor de cl en myArray[i]

```

```

i=0;

while (i<n_perf) {

    CL[alpha][i] = strtod(myArray[z].c_str(), NULL);

    z=z+13;

    V[alpha][i]=sqrt((M*g*2)/(S*rho*CL[alpha][i]));

    Re[alpha][i]=(V[alpha][i]*c[i]*rho)/(mu);

    //busca el reynolds corresponent a les dades 2D i agafa les polars
    //dels Reynolds que estan mes a prop del valor (+-):

    reyn=true;

    reynolds=10000;

    comp_re=0;

    while(reyn) {

        comp_re=reynolds/Re[alpha][i];

        if(comp_re>1) {

            reyn=false;

            Re_1[alpha][i]=reynolds;

            Re_2[alpha][i]=Re_1[alpha][i]-10000;

        } else {

            reynolds = reynolds + 10000;

        }

    }

    //end while reyn

    //legeix arxiu de dades 2D dels reynolds Re_1 i Re_2 i analitzem
    //el valor de cl_max de cada reynolds

    remove("C:/Users/Lluis
    Armengol/Desktop/TFG/PV2/2D/path_3D_1.txt");

    ofstream path_1("C:/Users/Lluis
    Armengol/Desktop/TFG/PV2/2D/path_3D_1.txt");

    path_1 <<Re_1[alpha][i]<<"_clmax.txt"<<endl;

    path_1.close();

    ifstream file1("C:/Users/Lluis
    Armengol/Desktop/TFG/PV2/2D/path_3D_1.txt");

```

```

        if(file1.is_open()) {
            while(file1>>tt) {
                file1 >> tt;
            }
        }

        remove("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_3D_2.txt");

        ofstream path_2("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_3D_2.txt");
        path_2 <<Re_2[alpha][i]<<"_clmax.txt"<<endl;
        path_2.close();

        ifstream file2("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_3D_2.txt");
        if(file2.is_open()) {
            while(file2>>rr) {
                file2 >> rr;
            }
        }

        remove("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_3D_cd1.txt");

        ofstream path_3("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_3D_cd1.txt");
        path_3 <<Re_1[alpha][i]<<"_cd.txt"<<endl;
        path_3.close();

        ifstream filedd1("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_3D_cd1.txt");
        if(filedd1.is_open()){
            while(filedd1>>dd1){
                filedd1 >> dd1;}
            }
        remove("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_3D_cd2.txt");

```

```

        ofstream path_4("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_3D_cd2.txt");
path_4 <<Re_2[alpha][i]<<"_cd.txt"<<endl;
path_4.close();

ifstream filedd2("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/2D/path_3D_cd2.txt");
if(filedd2.is_open()){
    while(filedd2>>dd2){
        filedd2 >> dd2;}
    }

path ="C:/Users/Lluis Armengol/Desktop/TFG/PV2/2D/";
filename_Re1=tt;
filename_Re2=rr;
filename_Re1_cd=dd1;
filename_Re2_cd=dd2;
path_file_1 = path + filename_Re1;
path_file_2 = path + filename_Re2;
path_file_3 = path + filename_Re1_cd;
path_file_4 = path + filename_Re2_cd;

p1=0;
ifstream file5(path_file_3.c_str());
file5 >> cd_Re1[p1];
p1++;
if(file5.is_open()) {
    while(file5>>cd_Re1[p1]) {
        p1++;
        file5>>cd_Re1[p1];
        p1++;
    }
}
cdf1[i]=strtod(cd_Re1[alpha+aa].c_str(), NULL);

```

```

cdp1[i]=strtod(cd_Re1[alpha+bb].c_str(), NULL);
p2=0;
ifstream file6(path_file_4.c_str());
file6 >> cd_Re2[p2];
p2++;
if(file6.is_open()) {
    while(file6>>cd_Re2[p2]) {
        p2++;
        file6 >> cd_Re2[p2];
        p2=p2+1;
    }
}
cdf2[i]=strtod(cd_Re2[alpha+aa].c_str(), NULL);
cdp2[i]=strtod(cd_Re2[alpha+bb].c_str(), NULL);

cdf[i]=(cdf1[i]+cdf2[i])/2;
cdp[i]=(cdp1[i]+cdp2[i])/2;

y[i]=(b1/(n_perf-1))*i;
if(i > 0){ Ab[i]=y[i]-y[i-1];
    cdfm[i]=Ab[i]*(cdf[i]+cdf[i-1])/2;
    cdpm[i]=Ab[i]*(cdp[i]+cdp[i-1]/2);
    CDfsum[alpha]=CDfsum[alpha]+cdfm[i];
    CDpsum[alpha]=CDpsum[alpha]+cdpm[i];
    CDf[alpha]=CDfsum[alpha]/((n_perf-1)*i);
    CDp[alpha]=CDpsum[alpha]/((n_perf-1)*i);
}

ifstream file3(path_file_1.c_str());
if(file3.is_open()) {
    while(file3>>dades_Re1) {
        file3 >> dades_Re1;
    }
}

```

```

        }

    }

    clmax_Re1=strtod(dades_Re1.c_str(), NULL);

    ifstream file4(path_file_2.c_str());

    if(file4.is_open()) {

        while(file4>>dades_Re2) {

            file4 >> dades_Re2;

        }

    }

    clmax_Re2=strtod(dades_Re2.c_str(), NULL);

    clmax[alpha][i]=(clmax_Re1+clmax_Re2)/2;

    abc=clmax[alpha][i];

    if( clmax[alpha][i]<CL[alpha][i] ) {

        a3D = false;

        i=n_perf;

        alpha_CLmax=alpha;

    } else {

        i=i+1;

    }

}//end while span (i)

alpha=alpha+1;

aa=aa+2;

bb=bb+2;

} //end while general (alpha)

//-----
//capçal de l'arxiu NACA_polar.txt:

remove("C:/Users/Lluis Armengol/Desktop/TFG/PV2/NACA_polar.txt");

ofstream capsal("C:/Users/Lluis Armengol/Desktop/TFG/PV2/NACA_polar.txt");

capsal << "xflr5 v6.10.03 " << endl << endl;

capsal << "Wing name :      ALA"<< endl;

```

```

    capsal << "Wing polar name : T2-VLM1-" << M << "kg-x60.000mm" << endl <<
endl;

    capsal
<<setw(7)<<"alpha"<<setw(11)<<"CL"<<setw(15)<<"CDi"<<setw(14)<<"CDv";
    capsal <<setw(14)<<"CD"<<setw(17)<<"CY"<<setw(15)<<"Cl"<<setw(15)<<"Cm";
    capsal
<<setw(15)<<"Cn"<<setw(15)<<"Cni"<<setw(15)<<"QInf"<<setw(15)<<"XCP"<< endl;
    //capsal << " alpha      CL      CDi      CDv      CD      CY      Cl      Cm
Cn      Cni      QInf      XCP" << endl;

    capsal.close();

f=0.01;
fff=24;

for(alpha_final=-2; alpha_final<(alpha_CLmax+1); alpha_final=alpha_final+1) {
    //cout<<"Alpha= "<<alpha_final<<endl; system("PAUSE");

//Creo arxiu de comandes per executar AVL i calcular CL i CD en funció d'alpha fins al
alpha_CLmax:

    ofstream                               comandes_TOT("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/Comandes/comandes_avl_TOT.txt");
    comandes_TOT <<"load"<<endl;
    comandes_TOT <<"ALA.avl"<<endl;
    comandes_TOT <<"oper"<<endl;
    comandes_TOT <<"A"<<endl;
    comandes_TOT <<"A"<<endl;
    comandes_TOT <<alpha_final<<endl;
    comandes_TOT <<"M"<<endl;
    comandes_TOT <<"M"<<endl;
    comandes_TOT <<M<<endl;
    comandes_TOT <<"D"<<endl;
    comandes_TOT <<"1.225"<<endl;
    comandes_TOT <<"G"<<endl;
    comandes_TOT <<g<<endl<<endl;
    comandes_TOT <<"X"<<endl;
    comandes_TOT <<"W"<<endl;

```

```

comandes_TOT <<"C:\\Users\\Lluis
Armengol\\Desktop\\TFG\\PV2\\3D\\forces.txt" << endl << endl;
comandes_TOT <<"QUIT" << endl;
comandes_TOT.close();

//Fer l'anàlisis de l'ala per un angles d'atac (alpha). Es crea un arxiu on es guarden els
coeficients en funció de l'angle

//executa AVL.exe

system("avl.exe<"C:\\Users\\Lluis
Armengol\\Desktop\\TFG\\PV2\\Comandes\\comandes_avl_TOT.txt");

//Llegeix l'arxiu "forces" creat per AVL amb els coeficients:

ifstream file5("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/3D/forces.txt");

if(file5.is_open()) {
    for(int j = 0; j < 200; j++) {
        file5 >> myArray_TOT[j];
    }
}

CL_TOT= strtod(myArray_TOT[100].c_str(), NULL);
CD_TOT= strtod(myArray_TOT[103].c_str(), NULL);
Vinf[alpha_final]=sqrt((M*g*2)/(S*rho*CL_TOT));
if(alpha_final<0){
    CDf[alpha_final]=CDf[0];
    CDp[alpha_final]=CDp[0];
}

//Selecciona només els valors de CL i CD de l'arxiu "forces":

ofstream polar_TOT("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/NACA_polar.txt", ofstream::app);

polar_TOT << setw(5) << alpha_final << setw(15) << CL_TOT <<
setw(15) << CD_TOT;

polar_TOT << setw(15) << CDf[alpha_final] << setw(15) << CDp[alpha_final];

polar_TOT << setw(15) << "0.00000" << setw(15) << "0.00000" << setw(15) <<
"0.01111";

polar_TOT << setw(15) << "0.00000" << setw(15) << "0.00000" << setw(15) <<
Vinf[alpha_final] << setw(15) << "0.01111" << endl;

```

```

        polar_TOT.close();

        f=f+ff;
        fff=fff-ffff;

    } //end for

//      SEGONA PART DEL PROGRAMA - EXECUCI" DE LA MAGAPP

    remove("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/MagAppConsolaV204/performance_input");

//Creo arxiu de performance_input:

    ifstream                                     pinput("C:/Users/Lluis
Armengol/Desktop/TFG/PV2/performance_input");

    pinput << "4                               > MODE: 0: Enlairament amb determinaci
√ de x_to; 1: Ascens i Creuer; 2: Enlairament (x_to), Ascens i creuer; 3: ACC Classic;
4: ACC15" << endl;

    pinput << "Dades ACC15:" << endl;

    pinput << "2.2                         - OEW: Pes de l'aeronau en buit [kg] (double)"
<< endl;

    pinput << "3                           - LF: Load factor at turn (double)" << endl;

    pinput << "1.0                         - FactCD_gir: factor per CD de gir -> CD_gir =
CD_max_read*FactCD_gir (double)" << endl;

    pinput << "1.5                         - Delta_tg: Increment del temps de gir calculat -> tg =
tg_calc + Delta_tg (double)" << endl;

    pinput << "120                         - t_total: Temps total per fer trams
[s] (double)" << endl;

    pinput << "Dades per l'Enlairament:" << endl;

    pinput << "A.txt   - polar_run: arxiu de dades a alpha constant (string)" << endl;

    pinput << S << "           - S: superfície de referència [m^2] (double)" <<
endl;

    pinput << "1.0                         - FactCL_max: Efecte de flaps -> CL_max =
CL_max_read*FactCL_max" << endl;

    pinput << rho << "           - rho: [kg/m^3] (double)" << endl;

    pinput << "0.0                         - v_wind: velocitat del vent [m/s] (double)" << endl;

    pinput << "60                          - x_to: distància d'enlairament [m] (double)" << endl;

    pinput << "0.0                         - theta_d: angle d'inclinació de la pista [° ] (double)"
<< endl;

```

```

        pinput << "0.07      - mu_rw: coeficient de fregament amb el terra [-] (double)"
<< endl;

        pinput << "1.2      - k: factor de seguretat a la velocitat d'enlairament [-]
(double)" << endl;

        pinput << "300      - n_discret: discretització de la pista [-] (uint)" << endl;

        pinput << "Dades per Ascens i Creuer:" << endl;

        pinput << rho << "      # rho: [kg/m^3] (double)" << endl;

        pinput << "NACA_polar.txt  # XFLR5_file: nom de l'arxiu d'XFLR5 (string)" <<
endl;

        pinput << "11.1      # Vbat: voltatge nominal de la bateria [V] (double)" <<
endl;

        pinput << "3450      # Q_I: capacitat de la bateria [mA*h] (double)" << endl;

        pinput << "1.0e-5     # Rbat: resistència interna de la bateria [Ohm]
(double)" << endl;

        pinput << "90.0      # Qres_pc: reserves de les bateries [%] (double)" <<
endl;

        pinput << "1.0e-5     # Resc: resistència interna de l'ESC [Ohm] (double)"
<< endl;

        pinput << "1      # r: relació de transmissió r=Omega_H/Omega_m [-]
(double)" << endl;

        pinput << "1.0      # eta_r: rendiment de la transmissió [tant x 1] (double)"
<< endl;

        pinput << "65      # C: C's de descàrrega de la bateria C=I_max/Q_I [-]
(double)" << endl;

        pinput << "AXI2826/10B    # motor: nom del motor a dins de la base de dades
Engine_data.dtb (string)" << endl;

        pinput << "1.0      # PI: Paràmetre PI del motor 0<=PI<=1 [-] (double)"
<< endl;

        pinput << "13x7_PS    # helix_nom" << endl;

        pinput << "1600     # Omega0: Llavor de la velocitat angular de l'helix
[rad/s] (double)" << endl;

        pinput << "1.0e-5     # tolerancia: Tolerància del mètode iteratiu [-]
(double)" << endl;

        pinput << "200      # maxIt: nombre màxim d'iteracions [-] (uint)" <<
endl;

        pinput.close();

```

```
//Creo arxiu comandes:
```

```
remove("C:/Users/Lluis  
Armengol/Desktop/TFG/PV2/Comandes/comandes_magapp.txt");  
  
ofstream mgapp("C:/Users/Lluis  
Armengol/Desktop/TFG/PV2/Comandes/comandes_magapp.txt");  
  
mgapp << endl;  
mgapp.close();
```

```
//Executo MagAppV204:
```

```
system("performance_consola_win.exe<"C:\\Users\\Lluis  
Armengol\\Desktop\\TFG\\PV2\\Comandes\\comandes_magapp.txt");  
  
ifstream file_mtw("C:/Users/Lluis Armengol/Desktop/TFG/PV2/MTOW.txt");  
  
if(file_mtw.is_open()){  
  
    while(file_mtw>>mtw){  
        file_mtw>>mtw;}  
    }  
  
    MTOW=strtod(mtw.c_str(), NULL);  
  
    if(M < MTOW && M/MTOW >= 0.90){  
  
        MTOW_OK = false;  
  
        remove("C:/Users/Lluis Armengol/Desktop/TFG/PV2/OEW.txt");  
  
        ofstream oew("C:/Users/Lluis Armengol/Desktop/TFG/PV2/OEW.txt");  
  
        oew << M << endl;  
  
        oew.close();}  
  
    else{  
  
        M = (M+MTOW)/2;}  
  
    } //end while MTOW_OK*/  
  
    return 0;  
}
```

ANNEX 3

Wing aerodynamics characteristics

Wing name : ALA

Wing polar name : T2-VLM1-5.16753kg-x60.000mm

alpha	CL	CDi	CDv	CD	CY	CI	Cm	Cn	Cni	QInf	XCP
-2	0.18284	0.00165	0.0210969	0.0215835	0.00000	0.00000	0.01111	0.00000	0.00000	29.1406	0.01111
-1	0.2606	0.00337	0.0210969	0.0215835	0.00000	0.00000	0.01111	0.00000	0.00000	24.4088	0.01111
0	0.33829	0.00575	0.0210969	0.0215835	0.00000	0.00000	0.01111	0.00000	0.00000	21.4234	0.01111
1	0.41586	0.0088	0.0218401	0.0228748	0.00000	0.00000	0.01111	0.00000	0.00000	19.3224	0.01111
2	0.49325	0.01251	0.0236635	0.0249468	0.00000	0.00000	0.01111	0.00000	0.00000	17.7419	0.01111
3	0.57039	0.01687	0.025797	0.0277807	0.00000	0.00000	0.01111	0.00000	0.00000	16.4986	0.01111
4	0.64724	0.02187	0.0279198	0.0311414	0.00000	0.00000	0.01111	0.00000	0.00000	15.4882	0.01111
5	0.72374	0.02752	0.0304837	0.0353094	0.00000	0.00000	0.01111	0.00000	0.00000	14.6468	0.01111
6	0.79982	0.03379	0.0332775	0.0401779	0.00000	0.00000	0.01111	0.00000	0.00000	13.9328	0.01111
7	0.87544	0.04068	0.0366328	0.0459394	0.00000	0.00000	0.01111	0.00000	0.00000	13.3174	0.01111
8	0.95053	0.04817	0.0396593	0.051741	0.00000	0.00000	0.01111	0.00000	0.00000	12.7806	0.01111

ANNEX 4

3 Generation Analysis. Best population:

This file contains the data of final feasible population (if found)

of objectives = 1, # of constraints = 0, # of real_var = 3, # of bits of bin_var = 0, constrViolation, rank, crowding_distance

8.320690e+002	1.489202e+000	4.622500e-001	1.462365e-001	0.000000e+000	1	1.000000e+014
---------------	---------------	---------------	---------------	---------------	---	---------------

6 Generation Analysis. Best population:

This file contains the data of final feasible population (if found)

of objectives = 1, # of constraints = 0, # of real_var = 3, # of bits of bin_var = 0, constrViolation, rank, crowding_distance

8.226500e+002	1.516194e+000	4.923718e-001	1.183844e-001	0.000000e+000	1	1.000000e+014
---------------	---------------	---------------	---------------	---------------	---	---------------

12 Generation Analysis. Best population:

This file contains the data of final feasible population (if found)

of objectives = 1, # of constraints = 0, # of real_var = 3, # of bits of bin_var = 0, constrViolation, rank, crowding_distance

8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	1	1.000000e+014
---------------	---------------	---------------	---------------	---------------	---	---------------

24 Generation Analysis. Best population:

This file contains the data of final feasible population (if found)

of objectives = 1, # of constraints = 0, # of real_var = 3, # of bits of bin_var = 0, constrViolation, rank, crowding_distance

8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
---------------	---------------	---------------	---------------	---------------	---	---------------

ANNEX 5

3 Generations analysis. All population

This file contains the data of all generations

of objectives = 1, # of constraints = 0, # of real_var = 3, # of bits of bin_var = 0, constrViolation, rank, crowdingDistance

gen = 1

8.568960e+002	1.479204e+000	3.481724e-0011.615054e-0010.000000e+000	4	1.000000e+014
8.899820e+002	1.252485e+000	3.137479e-0011.133011e-0010.000000e+000	11	1.000000e+014
8.744960e+002	1.366673e+000	3.226324e-0011.063246e-0010.000000e+000	8	1.000000e+014
8.960200e+002	1.017258e+000	3.627043e-0011.865011e-0010.000000e+000	12	1.000000e+014
8.827950e+002	1.125996e+000	3.954879e-0011.163688e-0010.000000e+000	9	1.000000e+014
8.887810e+002	1.064398e+000	3.640836e-0011.665580e-0010.000000e+000	10	1.000000e+014
8.439430e+002	1.336839e+000	4.586001e-0011.485070e-0010.000000e+000	2	1.000000e+014
8.476630e+002	1.268869e+000	4.997265e-0011.081460e-0010.000000e+000	3	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-0011.462365e-0010.000000e+000	1	1.000000e+014
8.667620e+002	1.047108e+000	4.919920e-0011.167472e-0010.000000e+000	7	1.000000e+014
8.667340e+002	1.195584e+000	4.432212e-0011.626554e-0010.000000e+000	6	1.000000e+014
8.661020e+002	1.089139e+000	4.674256e-0011.730023e-0010.000000e+000	5	1.000000e+014

gen = 2

8.390790e+002	1.452567e+000	4.298639e-0011.462365e-0010.000000e+000	1	1.000000e+014
8.400820e+002	1.446835e+000	4.289535e-0011.462365e-0010.000000e+000	2	1.000000e+014

8.424340e+002	1.336839e+000	4.654660e-0011.485070e-0010.000000e+000	3	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-0011.462365e-0010.000000e+000	4	1.000000e+014
8.439430e+002	1.336839e+000	4.586001e-0011.485070e-0010.000000e+000	5	1.000000e+014
8.476630e+002	1.268869e+000	4.997265e-0011.081460e-0010.000000e+000	6	1.000000e+014
8.518470e+002	1.268869e+000	4.701670e-0011.145646e-0010.000000e+000	7	1.000000e+014
8.568960e+002	1.479204e+000	3.481724e-0011.615054e-0010.000000e+000	8	1.000000e+014
8.589780e+002	1.089139e+000	4.986549e-0011.762262e-0010.000000e+000	9	1.000000e+014
8.615280e+002	1.087064e+000	4.923272e-0011.730023e-0010.000000e+000	10	1.000000e+014
8.625050e+002	1.479204e+000	3.481724e-0011.615054e-0010.000000e+000	11	1.000000e+014
8.629780e+002	1.222378e+000	4.432212e-0011.626554e-0010.000000e+000	12	1.000000e+014
# gen = 3				
8.320690e+002	1.489202e+000	4.622500e-0011.462365e-0010.000000e+000	1	1.000000e+014
8.342100e+002	1.454067e+000	4.701670e-0011.145646e-0010.000000e+000	2	1.000000e+014
8.388600e+002	1.446835e+000	4.289535e-0011.462365e-0010.000000e+000	3	1.000000e+014
8.390790e+002	1.452567e+000	4.298639e-0011.462365e-0010.000000e+000	4	1.000000e+014
8.400820e+002	1.446835e+000	4.289535e-0011.462365e-0010.000000e+000	5	1.000000e+014
8.407180e+002	1.482670e+000	4.289535e-0011.462365e-0010.000000e+000	6	1.000000e+014
8.424340e+002	1.336839e+000	4.654660e-0011.485070e-0010.000000e+000	7	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-0011.462365e-0010.000000e+000	8	1.000000e+014

8.439430e+002	1.336839e+000	4.586001e-001 1.485070e-001 0.000000e+000	9	1.000000e+014
8.442430e+002	1.434181e+000	4.289535e-001 1.462365e-001 0.000000e+000	10	1.000000e+014
8.451870e+002	1.452567e+000	4.216223e-001 1.462051e-001 0.000000e+000	11	1.000000e+014
8.457040e+002	1.337375e+000	4.669210e-001 1.485070e-001 0.000000e+000	12	1.000000e+014

6 Generations analysis. All population

This file contains the data of all generations

of objectives = 1, # of constraints = 0, # of real_var = 3, # of bits of bin_var = 0, constr_violation, rank, crowding_distance

gen = 1

8.056800e+009	1.479204e+000	3.481724e-001	1.615054e-001	0.000000e+000	10	1.000000e+014
8.056800e+009	1.252485e+000	3.137479e-001	1.133011e-001	0.000000e+000	10	0.000000e+000
8.056800e+009	1.366673e+000	3.226324e-001	1.063246e-001	0.000000e+000	10	0.000000e+000
8.979690e+002	1.017258e+000	3.627043e-001	1.865011e-001	0.000000e+000	9	1.000000e+014
8.827950e+002	1.125996e+000	3.954879e-001	1.163688e-001	0.000000e+000	7	1.000000e+014
8.887810e+002	1.064398e+000	3.640836e-001	1.665580e-001	0.000000e+000	8	1.000000e+014
8.439430e+002	1.336839e+000	4.586001e-001	1.485070e-001	0.000000e+000	2	1.000000e+014
8.476630e+002	1.268869e+000	4.997265e-001	1.081460e-001	0.000000e+000	3	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	1	1.000000e+014
8.667620e+002	1.047108e+000	4.919920e-001	1.167472e-001	0.000000e+000	6	1.000000e+014
8.667340e+002	1.195584e+000	4.432212e-001	1.626554e-001	0.000000e+000	5	1.000000e+014
8.661020e+002	1.089139e+000	4.674256e-001	1.730023e-001	0.000000e+000	4	1.000000e+014

gen = 2

8.276900e+002	1.432553e+000	4.927976e-001	1.167472e-001	0.000000e+000	1	1.000000e+014
8.405640e+002	1.263138e+000	4.997265e-001	1.081460e-001	0.000000e+000	2	1.000000e+014

8.436650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	3	1.000000e+014
8.437650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	4	1.000000e+014
8.439430e+002	1.336839e+000	4.586001e-001	1.485070e-001	0.000000e+000	5	1.000000e+014
8.463380e+002	1.336839e+000	4.586001e-001	1.456950e-001	0.000000e+000	6	1.000000e+014
8.468970e+002	1.336839e+000	4.586001e-001	1.485070e-001	0.000000e+000	7	1.000000e+014
8.476630e+002	1.268869e+000	4.997265e-001	1.081460e-001	0.000000e+000	8	1.000000e+014
8.522700e+002	1.125996e+000	4.958616e-001	1.179681e-001	0.000000e+000	9	1.000000e+014
8.640980e+002	1.195584e+000	4.432212e-001	1.626554e-001	0.000000e+000	10	1.000000e+014
8.641290e+002	1.089139e+000	4.742101e-001	1.730023e-001	0.000000e+000	11	1.000000e+014
8.641880e+002	1.073902e+000	4.919920e-001	1.167472e-001	0.000000e+000	12	1.000000e+014
# gen = 3						
8.270490e+002	1.432553e+000	4.927976e-001	1.163087e-001	0.000000e+000	1	1.000000e+014
8.276900e+002	1.432553e+000	4.927976e-001	1.167472e-001	0.000000e+000	2	1.000000e+014
8.364300e+002	1.469974e+000	4.549304e-001	1.485070e-001	0.000000e+000	3	1.000000e+014
8.393160e+002	1.336057e+000	4.927976e-001	1.167472e-001	0.000000e+000	4	1.000000e+014
8.395520e+002	1.488399e+000	4.289535e-001	1.492455e-001	0.000000e+000	5	1.000000e+014
8.405640e+002	1.263138e+000	4.997265e-001	1.081460e-001	0.000000e+000	6	1.000000e+014
8.411910e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	7	1.000000e+014
8.412320e+002	1.244752e+000	4.997265e-001	1.051822e-001	0.000000e+000	8	1.000000e+014

8.415890e+002	1.453480e+000	4.302126e-001	1.368043e-001	0.000000e+000	9	1.000000e+014
8.426900e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	10	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	11	1.000000e+014
8.437650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	12	1.000000e+014
# gen = 4						
8.270490e+002	1.432553e+000	4.927976e-001	1.163087e-001	0.000000e+000	1	1.000000e+014
8.272330e+002	1.432553e+000	4.878327e-001	1.167472e-001	0.000000e+000	2	1.000000e+014
8.276900e+002	1.432553e+000	4.927976e-001	1.167472e-001	0.000000e+000	3	1.000000e+014
8.316890e+002	1.432553e+000	4.947456e-001	1.163087e-001	0.000000e+000	4	1.000000e+014
8.324700e+002	1.435427e+000	4.928591e-001	1.055946e-001	0.000000e+000	5	1.000000e+014
8.327800e+002	1.432553e+000	4.922696e-001	1.183776e-001	0.000000e+000	6	1.000000e+014
8.347410e+002	1.469974e+000	4.529496e-001	1.485070e-001	0.000000e+000	7	1.000000e+014
8.356150e+002	1.469974e+000	4.474232e-001	1.483169e-001	0.000000e+000	8	1.000000e+014
8.364300e+002	1.469974e+000	4.549304e-001	1.485070e-001	0.000000e+000	9	1.000000e+014
8.377970e+002	1.488399e+000	4.289535e-001	1.483162e-001	0.000000e+000	10	1.000000e+014
8.393160e+002	1.336057e+000	4.927976e-001	1.167472e-001	0.000000e+000	11	1.000000e+014
8.395500e+002	1.488399e+000	4.294432e-001	1.471766e-001	0.000000e+000	12	1.000000e+014
# gen = 5						
8.231200e+002	1.479246e+000	4.849472e-001	1.167472e-001	0.000000e+000	1	1.000000e+014

8.240750e+002	1.516831e+000	4.923718e-001	1.183776e-001	0.000000e+000	2	1.000000e+014
8.241570e+002	1.469001e+000	4.857979e-001	1.499106e-001	0.000000e+000	3	1.000000e+014
8.270490e+002	1.432553e+000	4.927976e-001	1.163087e-001	0.000000e+000	4	1.000000e+014
8.272330e+002	1.432553e+000	4.878327e-001	1.167472e-001	0.000000e+000	5	1.000000e+014
8.276900e+002	1.432553e+000	4.927976e-001	1.167472e-001	0.000000e+000	6	1.000000e+014
8.291280e+002	1.432553e+000	4.944599e-001	1.183776e-001	0.000000e+000	7	1.000000e+014
8.295640e+002	1.432553e+000	4.984010e-001	1.163087e-001	0.000000e+000	8	1.000000e+014
8.307830e+002	1.435514e+000	4.928559e-001	1.029481e-001	0.000000e+000	9	1.000000e+014
8.310280e+002	1.432553e+000	4.927976e-001	1.163087e-001	0.000000e+000	10	1.000000e+014
8.311180e+002	1.432553e+000	4.922157e-001	1.213993e-001	0.000000e+000	11	1.000000e+014
8.316890e+002	1.432553e+000	4.947456e-001	1.163087e-001	0.000000e+000	12	1.000000e+014
# gen = 6						
8.226500e+002	1.516194e+000	4.923718e-001	1.183844e-001	0.000000e+000	1	1.000000e+014
8.231200e+002	1.479246e+000	4.849472e-001	1.167472e-001	0.000000e+000	2	1.000000e+014
8.235050e+002	1.516831e+000	4.923718e-001	1.183776e-001	0.000000e+000	3	1.000000e+014
8.240750e+002	1.516831e+000	4.923718e-001	1.183776e-001	0.000000e+000	4	1.000000e+014
8.241570e+002	1.469001e+000	4.857979e-001	1.499106e-001	0.000000e+000	5	1.000000e+014
8.263930e+002	1.469123e+000	4.927976e-001	1.164712e-001	0.000000e+000	6	1.000000e+014
8.270490e+002	1.432553e+000	4.927976e-001	1.163087e-001	0.000000e+000	7	1.000000e+014

8.272330e+002	1.432553e+000	4.878327e-001	1.167472e-001	0.000000e+000	8	1.000000e+014
8.272820e+002	1.479246e+000	4.887208e-001	1.115199e-001	0.000000e+000	9	1.000000e+014
8.276900e+002	1.432553e+000	4.927976e-001	1.167472e-001	0.000000e+000	10	1.000000e+014
8.278830e+002	1.468966e+000	4.894407e-001	1.208692e-001	0.000000e+000	11	1.000000e+014
8.280760e+002	1.479246e+000	4.849472e-001	1.167472e-001	0.000000e+000	12	1.000000e+014

12 Generations analysis. All population

This file contains the data of all generations

of objectives = 1, # of constraints = 0, # of real_var = 3, # of bits of bin_var = 0, constr_violation, rank, crowding_distance

gen = 1

8.576670e+002	1.479204e+000	3.481724e-001	1.615054e-001	0.000000e+000	4	1.000000e+014
8.899820e+002	1.252485e+000	3.137479e-001	1.133011e-001	0.000000e+000	11	1.000000e+014
8.744960e+002	1.366673e+000	3.226324e-001	1.063246e-001	0.000000e+000	8	1.000000e+014
8.960200e+002	1.017258e+000	3.627043e-001	1.865011e-001	0.000000e+000	12	1.000000e+014
8.827950e+002	1.125996e+000	3.954879e-001	1.163688e-001	0.000000e+000	9	1.000000e+014
8.887810e+002	1.064398e+000	3.640836e-001	1.665580e-001	0.000000e+000	10	1.000000e+014
8.439430e+002	1.336839e+000	4.586001e-001	1.485070e-001	0.000000e+000	2	1.000000e+014
8.476630e+002	1.268869e+000	4.997265e-001	1.081460e-001	0.000000e+000	3	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	1	1.000000e+014
8.667620e+002	1.047108e+000	4.919920e-001	1.167472e-001	0.000000e+000	7	1.000000e+014
8.667340e+002	1.195584e+000	4.432212e-001	1.626554e-001	0.000000e+000	6	1.000000e+014
8.661020e+002	1.089139e+000	4.674256e-001	1.730023e-001	0.000000e+000	5	1.000000e+014

gen = 2

8.390790e+002	1.452567e+000	4.298639e-001	1.462365e-001	0.000000e+000	1	1.000000e+014
8.400820e+002	1.446835e+000	4.289535e-001	1.462365e-001	0.000000e+000	2	1.000000e+014

8.424340e+002	1.336839e+000	4.654660e-001	1.485070e-001	0.000000e+000	3	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	4	1.000000e+014
8.439430e+002	1.336839e+000	4.586001e-001	1.485070e-001	0.000000e+000	5	1.000000e+014
8.476630e+002	1.268869e+000	4.997265e-001	1.081460e-001	0.000000e+000	6	1.000000e+014
8.518470e+002	1.268869e+000	4.701670e-001	1.145646e-001	0.000000e+000	7	1.000000e+014
8.576670e+002	1.479204e+000	3.481724e-001	1.615054e-001	0.000000e+000	8	1.000000e+014
8.589780e+002	1.089139e+000	4.986549e-001	1.762262e-001	0.000000e+000	9	1.000000e+014
8.615280e+002	1.087064e+000	4.923272e-001	1.730023e-001	0.000000e+000	10	1.000000e+014
8.625050e+002	1.479204e+000	3.481724e-001	1.615054e-001	0.000000e+000	11	1.000000e+014
8.629780e+002	1.222378e+000	4.432212e-001	1.626554e-001	0.000000e+000	12	1.000000e+014
# gen = 3						
8.320690e+002	1.489202e+000	4.622500e-001	1.462365e-001	0.000000e+000	1	1.000000e+014
8.342100e+002	1.454067e+000	4.701670e-001	1.145646e-001	0.000000e+000	2	1.000000e+014
8.388600e+002	1.446835e+000	4.289535e-001	1.462365e-001	0.000000e+000	3	1.000000e+014
8.390790e+002	1.452567e+000	4.298639e-001	1.462365e-001	0.000000e+000	4	1.000000e+014
8.400820e+002	1.446835e+000	4.289535e-001	1.462365e-001	0.000000e+000	5	1.000000e+014
8.407180e+002	1.482670e+000	4.289535e-001	1.462365e-001	0.000000e+000	6	1.000000e+014
8.424340e+002	1.336839e+000	4.654660e-001	1.485070e-001	0.000000e+000	7	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	8	1.000000e+014

8.439430e+002	1.336839e+000	4.586001e-001	1.485070e-001	0.000000e+000	9	1.000000e+014
8.442430e+002	1.434181e+000	4.289535e-001	1.462365e-001	0.000000e+000	10	1.000000e+014
8.451870e+002	1.452567e+000	4.216223e-001	1.462051e-001	0.000000e+000	11	1.000000e+014
8.457040e+002	1.337375e+000	4.669210e-001	1.485070e-001	0.000000e+000	12	1.000000e+014
# gen = 4						
8.268450e+002	1.489801e+000	4.622500e-001	1.462365e-001	0.000000e+000	1	1.000000e+014
8.271040e+002	1.482572e+000	4.666889e-001	1.497619e-001	0.000000e+000	2	1.000000e+014
8.298000e+002	1.454067e+000	4.701670e-001	1.145646e-001	0.000000e+000	3	1.000000e+014
8.300590e+002	1.453510e+000	4.701670e-001	1.152998e-001	0.000000e+000	4	1.000000e+014
8.317610e+002	1.457983e+000	4.583376e-001	1.485070e-001	0.000000e+000	5	1.000000e+014
8.320690e+002	1.489202e+000	4.622500e-001	1.462365e-001	0.000000e+000	6	1.000000e+014
8.342100e+002	1.454067e+000	4.701670e-001	1.145646e-001	0.000000e+000	7	1.000000e+014
8.372850e+002	1.452567e+000	4.601528e-001	1.433240e-001	0.000000e+000	8	1.000000e+014
8.379240e+002	1.489202e+000	4.319611e-001	1.462365e-001	0.000000e+000	9	1.000000e+014
8.388600e+002	1.446835e+000	4.289535e-001	1.462365e-001	0.000000e+000	10	1.000000e+014
8.390790e+002	1.452567e+000	4.298639e-001	1.462365e-001	0.000000e+000	11	1.000000e+014
8.400820e+002	1.446835e+000	4.289535e-001	1.462365e-001	0.000000e+000	12	1.000000e+014
# gen = 5						
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	1	1.000000e+014

8.268450e+002	1.489801e+000	4.622500e-001	1.462365e-001	0.000000e+000	2	1.000000e+014
8.271040e+002	1.482572e+000	4.666889e-001	1.497619e-001	0.000000e+000	3	1.000000e+014
8.298000e+002	1.454067e+000	4.701670e-001	1.145646e-001	0.000000e+000	4	1.000000e+014
8.300590e+002	1.453510e+000	4.701670e-001	1.152998e-001	0.000000e+000	5	1.000000e+014
8.301790e+002	1.498685e+000	4.666889e-001	1.497619e-001	0.000000e+000	6	1.000000e+014
8.317610e+002	1.457983e+000	4.583376e-001	1.485070e-001	0.000000e+000	7	1.000000e+014
8.320690e+002	1.489202e+000	4.622500e-001	1.462365e-001	0.000000e+000	8	1.000000e+014
8.322660e+002	1.463083e+000	4.733662e-001	1.155475e-001	0.000000e+000	9	1.000000e+014
8.323320e+002	1.481747e+000	4.667010e-001	1.433770e-001	0.000000e+000	10	1.000000e+014
8.323620e+002	1.489790e+000	4.621482e-001	1.447108e-001	0.000000e+000	11	1.000000e+014
8.326230e+002	1.494109e+000	4.592457e-001	1.181931e-001	0.000000e+000	12	1.000000e+014
# gen = 6						
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	1	1.000000e+014
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	2	1.000000e+014
8.267990e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	3	1.000000e+014
8.268450e+002	1.489801e+000	4.622500e-001	1.462365e-001	0.000000e+000	4	1.000000e+014
8.271040e+002	1.482572e+000	4.666889e-001	1.497619e-001	0.000000e+000	5	1.000000e+014
8.283410e+002	1.504369e+000	4.707091e-001	1.462365e-001	0.000000e+000	6	1.000000e+014
8.284310e+002	1.539504e+000	4.583376e-001	1.146929e-001	0.000000e+000	7	1.000000e+014

8.292230e+002	1.500376e+000	4.736830e-001	1.557760e-001	0.000000e+000	8	1.000000e+014
8.296650e+002	1.513074e+000	4.560415e-001	1.497619e-001	0.000000e+000	9	1.000000e+014
8.298000e+002	1.454067e+000	4.701670e-001	1.145646e-001	0.000000e+000	10	1.000000e+014
8.300590e+002	1.453510e+000	4.701670e-001	1.152998e-001	0.000000e+000	11	1.000000e+014
8.301790e+002	1.498685e+000	4.666889e-001	1.497619e-001	0.000000e+000	12	1.000000e+014
# gen = 7						
8.179120e+002	1.568711e+000	4.665894e-001	1.151629e-001	0.000000e+000	1	1.000000e+014
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	2	1.000000e+014
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	3	1.000000e+014
8.217560e+002	1.573895e+000	4.736830e-001	1.137176e-001	0.000000e+000	4	1.000000e+014
8.259130e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	5	1.000000e+014
8.262390e+002	1.542186e+000	4.701812e-001	1.152998e-001	0.000000e+000	6	1.000000e+014
8.267990e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	7	1.000000e+014
8.268450e+002	1.489801e+000	4.622500e-001	1.462365e-001	0.000000e+000	8	1.000000e+014
8.271040e+002	1.482572e+000	4.666889e-001	1.497619e-001	0.000000e+000	9	1.000000e+014
8.273930e+002	1.500232e+000	4.697986e-001	1.572217e-001	0.000000e+000	10	1.000000e+014
8.276760e+002	1.504369e+000	4.706949e-001	1.462365e-001	0.000000e+000	11	1.000000e+014
8.283410e+002	1.504369e+000	4.707091e-001	1.462365e-001	0.000000e+000	12	1.000000e+014
# gen = 8						

8.179120e+002	1.568711e+000	4.665894e-001	1.151629e-001	0.000000e+000	1	1.000000e+014
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	2	1.000000e+014
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	3	1.000000e+014
8.217560e+002	1.573895e+000	4.736830e-001	1.137176e-001	0.000000e+000	4	1.000000e+014
8.227850e+002	1.564735e+000	4.698020e-001	1.145315e-001	0.000000e+000	5	1.000000e+014
8.229880e+002	1.573405e+000	4.701484e-001	1.162762e-001	0.000000e+000	6	1.000000e+014
8.234120e+002	1.568751e+000	4.666443e-001	1.151629e-001	0.000000e+000	7	1.000000e+014
8.238450e+002	1.568711e+000	4.665894e-001	1.177967e-001	0.000000e+000	8	1.000000e+014
8.247590e+002	1.527314e+000	4.737017e-001	1.153017e-001	0.000000e+000	9	1.000000e+014
8.249700e+002	1.542147e+000	4.695882e-001	1.152998e-001	0.000000e+000	10	1.000000e+014
8.259020e+002	1.540142e+000	4.697984e-001	1.152998e-001	0.000000e+000	11	1.000000e+014
8.259130e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	12	1.000000e+014
# gen = 9						
8.179120e+002	1.568711e+000	4.665894e-001	1.151629e-001	0.000000e+000	1	1.000000e+014
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	2	1.000000e+014
8.203550e+002	1.568711e+000	4.820314e-001	1.151629e-001	0.000000e+000	3	1.000000e+014
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	4	1.000000e+014
8.210300e+002	1.574341e+000	4.781929e-001	1.152888e-001	0.000000e+000	5	1.000000e+014
8.211950e+002	1.573386e+000	4.736190e-001	1.162986e-001	0.000000e+000	6	1.000000e+014

8.213950e+002	1.573913e+000	4.702124e-001	1.164483e-001	0.000000e+000	7	1.000000e+014
8.217560e+002	1.573895e+000	4.736830e-001	1.137176e-001	0.000000e+000	8	1.000000e+014
8.227850e+002	1.564735e+000	4.698020e-001	1.145315e-001	0.000000e+000	9	1.000000e+014
8.228780e+002	1.570873e+000	4.665894e-001	1.151629e-001	0.000000e+000	10	1.000000e+014
8.229880e+002	1.573405e+000	4.701484e-001	1.162762e-001	0.000000e+000	11	1.000000e+014
8.230840e+002	1.568751e+000	4.666456e-001	1.151629e-001	0.000000e+000	12	1.000000e+014
# gen = 10						
8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	1	1.000000e+014
8.179120e+002	1.568711e+000	4.665894e-001	1.151629e-001	0.000000e+000	2	1.000000e+014
8.181110e+002	1.568711e+000	4.942893e-001	1.038840e-001	0.000000e+000	3	1.000000e+014
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	4	1.000000e+014
8.198390e+002	1.575493e+000	4.822036e-001	1.151629e-001	0.000000e+000	5	1.000000e+014
8.203190e+002	1.572897e+000	4.701670e-001	1.139022e-001	0.000000e+000	6	1.000000e+014
8.203550e+002	1.568711e+000	4.820314e-001	1.151629e-001	0.000000e+000	7	1.000000e+014
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	8	1.000000e+014
8.204980e+002	1.603055e+000	4.697986e-001	1.155717e-001	0.000000e+000	9	1.000000e+014
8.208180e+002	1.573913e+000	4.702124e-001	1.187638e-001	0.000000e+000	10	1.000000e+014
8.210300e+002	1.574341e+000	4.781929e-001	1.152888e-001	0.000000e+000	11	1.000000e+014
8.211950e+002	1.573386e+000	4.736190e-001	1.162986e-001	0.000000e+000	12	1.000000e+014

gen = 11

8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	1	1.000000e+014
8.090730e+002	1.646564e+000	4.715103e-001	1.137176e-001	0.000000e+000	2	1.000000e+014
8.107120e+002	1.621007e+000	4.749129e-001	1.136978e-001	0.000000e+000	3	1.000000e+014
8.171830e+002	1.606572e+000	4.822578e-001	1.152055e-001	0.000000e+000	4	1.000000e+014
8.174810e+002	1.568765e+000	4.942893e-001	1.004023e-001	0.000000e+000	5	1.000000e+014
8.179120e+002	1.568711e+000	4.665894e-001	1.151629e-001	0.000000e+000	6	1.000000e+014
8.181110e+002	1.568711e+000	4.942893e-001	1.038840e-001	0.000000e+000	7	1.000000e+014
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	8	1.000000e+014
8.196860e+002	1.568711e+000	4.820314e-001	1.152920e-001	0.000000e+000	9	1.000000e+014
8.198390e+002	1.575493e+000	4.822036e-001	1.151629e-001	0.000000e+000	10	1.000000e+014
8.203190e+002	1.572897e+000	4.701670e-001	1.139022e-001	0.000000e+000	11	1.000000e+014
8.203550e+002	1.568711e+000	4.820314e-001	1.151629e-001	0.000000e+000	12	1.000000e+014

gen = 12

8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	1	1.000000e+014
8.090730e+002	1.646564e+000	4.715103e-001	1.137176e-001	0.000000e+000	2	1.000000e+014
8.104800e+002	1.606572e+000	4.822578e-001	1.152055e-001	0.000000e+000	3	1.000000e+014
8.107120e+002	1.621007e+000	4.749129e-001	1.136978e-001	0.000000e+000	4	1.000000e+014
8.144370e+002	1.644163e+000	4.731043e-001	1.004023e-001	0.000000e+000	5	1.000000e+014

8.150290e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	6	1.000000e+014
8.157620e+002	1.646564e+000	4.736424e-001	1.152046e-001	0.000000e+000	7	1.000000e+014
8.163630e+002	1.570849e+000	4.945301e-001	1.137176e-001	0.000000e+000	8	1.000000e+014
8.171830e+002	1.606572e+000	4.822578e-001	1.152055e-001	0.000000e+000	9	1.000000e+014
8.174810e+002	1.568765e+000	4.942893e-001	1.004023e-001	0.000000e+000	10	1.000000e+014
8.176500e+002	1.646564e+000	4.545208e-001	1.137176e-001	0.000000e+000	11	1.000000e+014
8.177400e+002	1.568765e+000	4.974805e-001	1.000487e-001	0.000000e+000	12	1.000000e+014

24 Generations analysis. All population

This file contains the data of all generations

of objectives = 1, # of constraints = 0, # of real_var = 3, # of bits of bin_var = 0, constr_violation, rank, crowding_distance

gen = 1

8.574740e+002	1.479204e+000	3.481724e-001	1.615054e-001	0.000000e+000	4	1.000000e+014
8.899820e+002	1.252485e+000	3.137479e-001	1.133011e-001	0.000000e+000	11	1.000000e+014
8.744960e+002	1.366673e+000	3.226324e-001	1.063246e-001	0.000000e+000	8	1.000000e+014
8.960200e+002	1.017258e+000	3.627043e-001	1.865011e-001	0.000000e+000	12	1.000000e+014
8.827950e+002	1.125996e+000	3.954879e-001	1.163688e-001	0.000000e+000	9	1.000000e+014
8.887810e+002	1.064398e+000	3.640836e-001	1.665580e-001	0.000000e+000	10	1.000000e+014
8.439430e+002	1.336839e+000	4.586001e-001	1.485070e-001	0.000000e+000	2	1.000000e+014
8.476630e+002	1.268869e+000	4.997265e-001	1.081460e-001	0.000000e+000	3	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	1	1.000000e+014
8.667620e+002	1.047108e+000	4.919920e-001	1.167472e-001	0.000000e+000	7	1.000000e+014
8.667340e+002	1.195584e+000	4.432212e-001	1.626554e-001	0.000000e+000	6	1.000000e+014
8.661020e+002	1.089139e+000	4.674256e-001	1.730023e-001	0.000000e+000	5	1.000000e+014

gen = 2

8.390790e+002	1.452567e+000	4.298639e-001	1.462365e-001	0.000000e+000	1	1.000000e+014
8.400820e+002	1.446835e+000	4.289535e-001	1.462365e-001	0.000000e+000	2	1.000000e+014

8.424340e+002	1.336839e+000	4.654660e-001	1.485070e-001	0.000000e+000	3	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	4	1.000000e+014
8.439430e+002	1.336839e+000	4.586001e-001	1.485070e-001	0.000000e+000	5	1.000000e+014
8.476630e+002	1.268869e+000	4.997265e-001	1.081460e-001	0.000000e+000	6	1.000000e+014
8.518470e+002	1.268869e+000	4.701670e-001	1.145646e-001	0.000000e+000	7	1.000000e+014
8.574740e+002	1.479204e+000	3.481724e-001	1.615054e-001	0.000000e+000	8	1.000000e+014
8.589780e+002	1.089139e+000	4.986549e-001	1.762262e-001	0.000000e+000	9	1.000000e+014
8.615280e+002	1.087064e+000	4.923272e-001	1.730023e-001	0.000000e+000	10	1.000000e+014
8.625050e+002	1.479204e+000	3.481724e-001	1.615054e-001	0.000000e+000	11	1.000000e+014
8.629780e+002	1.222378e+000	4.432212e-001	1.626554e-001	0.000000e+000	12	1.000000e+014
# gen = 3						
8.320690e+002	1.489202e+000	4.622500e-001	1.462365e-001	0.000000e+000	1	1.000000e+014
8.342100e+002	1.454067e+000	4.701670e-001	1.145646e-001	0.000000e+000	2	1.000000e+014
8.388600e+002	1.446835e+000	4.289535e-001	1.462365e-001	0.000000e+000	3	1.000000e+014
8.390790e+002	1.452567e+000	4.298639e-001	1.462365e-001	0.000000e+000	4	1.000000e+014
8.400820e+002	1.446835e+000	4.289535e-001	1.462365e-001	0.000000e+000	5	1.000000e+014
8.407180e+002	1.482670e+000	4.289535e-001	1.462365e-001	0.000000e+000	6	1.000000e+014
8.424340e+002	1.336839e+000	4.654660e-001	1.485070e-001	0.000000e+000	7	1.000000e+014
8.436650e+002	1.452567e+000	4.289535e-001	1.462365e-001	0.000000e+000	8	1.000000e+014

8.439430e+002	1.336839e+000	4.586001e-001	1.485070e-001	0.000000e+000	9	1.000000e+014
8.442430e+002	1.434181e+000	4.289535e-001	1.462365e-001	0.000000e+000	10	1.000000e+014
8.451870e+002	1.452567e+000	4.216223e-001	1.462051e-001	0.000000e+000	11	1.000000e+014
8.457040e+002	1.337375e+000	4.669210e-001	1.485070e-001	0.000000e+000	12	1.000000e+014
# gen = 4						
8.268450e+002	1.489801e+000	4.622500e-001	1.462365e-001	0.000000e+000	1	1.000000e+014
8.271040e+002	1.482572e+000	4.666889e-001	1.497619e-001	0.000000e+000	2	1.000000e+014
8.298000e+002	1.454067e+000	4.701670e-001	1.145646e-001	0.000000e+000	3	1.000000e+014
8.300590e+002	1.453510e+000	4.701670e-001	1.152998e-001	0.000000e+000	4	1.000000e+014
8.317610e+002	1.457983e+000	4.583376e-001	1.485070e-001	0.000000e+000	5	1.000000e+014
8.320690e+002	1.489202e+000	4.622500e-001	1.462365e-001	0.000000e+000	6	1.000000e+014
8.342100e+002	1.454067e+000	4.701670e-001	1.145646e-001	0.000000e+000	7	1.000000e+014
8.372850e+002	1.452567e+000	4.601528e-001	1.433240e-001	0.000000e+000	8	1.000000e+014
8.379240e+002	1.489202e+000	4.319611e-001	1.462365e-001	0.000000e+000	9	1.000000e+014
8.388600e+002	1.446835e+000	4.289535e-001	1.462365e-001	0.000000e+000	10	1.000000e+014
8.390790e+002	1.452567e+000	4.298639e-001	1.462365e-001	0.000000e+000	11	1.000000e+014
8.400820e+002	1.446835e+000	4.289535e-001	1.462365e-001	0.000000e+000	12	1.000000e+014
# gen = 5						
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	1	1.000000e+014

8.268450e+002	1.489801e+000	4.622500e-001	1.462365e-001	0.000000e+000	2	1.000000e+014
8.271040e+002	1.482572e+000	4.666889e-001	1.497619e-001	0.000000e+000	3	1.000000e+014
8.298000e+002	1.454067e+000	4.701670e-001	1.145646e-001	0.000000e+000	4	1.000000e+014
8.300590e+002	1.453510e+000	4.701670e-001	1.152998e-001	0.000000e+000	5	1.000000e+014
8.301790e+002	1.498685e+000	4.666889e-001	1.497619e-001	0.000000e+000	6	1.000000e+014
8.317610e+002	1.457983e+000	4.583376e-001	1.485070e-001	0.000000e+000	7	1.000000e+014
8.320690e+002	1.489202e+000	4.622500e-001	1.462365e-001	0.000000e+000	8	1.000000e+014
8.322660e+002	1.463083e+000	4.733662e-001	1.155475e-001	0.000000e+000	9	1.000000e+014
8.323320e+002	1.481747e+000	4.667010e-001	1.433770e-001	0.000000e+000	10	1.000000e+014
8.323620e+002	1.489790e+000	4.621482e-001	1.447108e-001	0.000000e+000	11	1.000000e+014
8.326230e+002	1.494109e+000	4.592457e-001	1.181931e-001	0.000000e+000	12	1.000000e+014
# gen = 6						
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	1	1.000000e+014
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	2	1.000000e+014
8.267990e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	3	1.000000e+014
8.268450e+002	1.489801e+000	4.622500e-001	1.462365e-001	0.000000e+000	4	1.000000e+014
8.271040e+002	1.482572e+000	4.666889e-001	1.497619e-001	0.000000e+000	5	1.000000e+014
8.283410e+002	1.504369e+000	4.707091e-001	1.462365e-001	0.000000e+000	6	1.000000e+014
8.284310e+002	1.539504e+000	4.583376e-001	1.146929e-001	0.000000e+000	7	1.000000e+014

8.292230e+002	1.500376e+000	4.736830e-001	1.557760e-001	0.000000e+000	8	1.000000e+014
8.296650e+002	1.513074e+000	4.560415e-001	1.497619e-001	0.000000e+000	9	1.000000e+014
8.298000e+002	1.454067e+000	4.701670e-001	1.145646e-001	0.000000e+000	10	1.000000e+014
8.300590e+002	1.453510e+000	4.701670e-001	1.152998e-001	0.000000e+000	11	1.000000e+014
8.301790e+002	1.498685e+000	4.666889e-001	1.497619e-001	0.000000e+000	12	1.000000e+014
# gen = 7						
8.179120e+002	1.568711e+000	4.665894e-001	1.151629e-001	0.000000e+000	1	1.000000e+014
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	2	1.000000e+014
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	3	1.000000e+014
8.217560e+002	1.573895e+000	4.736830e-001	1.137176e-001	0.000000e+000	4	1.000000e+014
8.259130e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	5	1.000000e+014
8.262390e+002	1.542186e+000	4.701812e-001	1.152998e-001	0.000000e+000	6	1.000000e+014
8.267990e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	7	1.000000e+014
8.268450e+002	1.489801e+000	4.622500e-001	1.462365e-001	0.000000e+000	8	1.000000e+014
8.271040e+002	1.482572e+000	4.666889e-001	1.497619e-001	0.000000e+000	9	1.000000e+014
8.273930e+002	1.500232e+000	4.697986e-001	1.572217e-001	0.000000e+000	10	1.000000e+014
8.276760e+002	1.504369e+000	4.706949e-001	1.462365e-001	0.000000e+000	11	1.000000e+014
8.283410e+002	1.504369e+000	4.707091e-001	1.462365e-001	0.000000e+000	12	1.000000e+014
# gen = 8						

8.179120e+002	1.568711e+000	4.665894e-001	1.151629e-001	0.000000e+000	1	1.000000e+014
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	2	1.000000e+014
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	3	1.000000e+014
8.217560e+002	1.573895e+000	4.736830e-001	1.137176e-001	0.000000e+000	4	1.000000e+014
8.227850e+002	1.564735e+000	4.698020e-001	1.145315e-001	0.000000e+000	5	1.000000e+014
8.229880e+002	1.573405e+000	4.701484e-001	1.162762e-001	0.000000e+000	6	1.000000e+014
8.234120e+002	1.568751e+000	4.666443e-001	1.151629e-001	0.000000e+000	7	1.000000e+014
8.238450e+002	1.568711e+000	4.665894e-001	1.177967e-001	0.000000e+000	8	1.000000e+014
8.247590e+002	1.527314e+000	4.737017e-001	1.153017e-001	0.000000e+000	9	1.000000e+014
8.249700e+002	1.542147e+000	4.695882e-001	1.152998e-001	0.000000e+000	10	1.000000e+014
8.259020e+002	1.540142e+000	4.697984e-001	1.152998e-001	0.000000e+000	11	1.000000e+014
8.259130e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	12	1.000000e+014
# gen = 9						
8.179120e+002	1.568711e+000	4.665894e-001	1.151629e-001	0.000000e+000	1	1.000000e+014
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	2	1.000000e+014
8.203550e+002	1.568711e+000	4.820314e-001	1.151629e-001	0.000000e+000	3	1.000000e+014
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	4	1.000000e+014
8.210300e+002	1.574341e+000	4.781929e-001	1.152888e-001	0.000000e+000	5	1.000000e+014
8.211950e+002	1.573386e+000	4.736190e-001	1.162986e-001	0.000000e+000	6	1.000000e+014

8.213950e+002	1.573913e+000	4.702124e-001	1.164483e-001	0.000000e+000	7	1.000000e+014
8.217560e+002	1.573895e+000	4.736830e-001	1.137176e-001	0.000000e+000	8	1.000000e+014
8.227850e+002	1.564735e+000	4.698020e-001	1.145315e-001	0.000000e+000	9	1.000000e+014
8.228780e+002	1.570873e+000	4.665894e-001	1.151629e-001	0.000000e+000	10	1.000000e+014
8.229880e+002	1.573405e+000	4.701484e-001	1.162762e-001	0.000000e+000	11	1.000000e+014
8.230840e+002	1.568751e+000	4.666456e-001	1.151629e-001	0.000000e+000	12	1.000000e+014
# gen = 10						
8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	1	1.000000e+014
8.179120e+002	1.568711e+000	4.665894e-001	1.151629e-001	0.000000e+000	2	1.000000e+014
8.181110e+002	1.568711e+000	4.942893e-001	1.038840e-001	0.000000e+000	3	1.000000e+014
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	4	1.000000e+014
8.198390e+002	1.575493e+000	4.822036e-001	1.151629e-001	0.000000e+000	5	1.000000e+014
8.203190e+002	1.572897e+000	4.701670e-001	1.139022e-001	0.000000e+000	6	1.000000e+014
8.203550e+002	1.568711e+000	4.820314e-001	1.151629e-001	0.000000e+000	7	1.000000e+014
8.204800e+002	1.536756e+000	4.697986e-001	1.151629e-001	0.000000e+000	8	1.000000e+014
8.204980e+002	1.603055e+000	4.697986e-001	1.155717e-001	0.000000e+000	9	1.000000e+014
8.208180e+002	1.573913e+000	4.702124e-001	1.187638e-001	0.000000e+000	10	1.000000e+014
8.210300e+002	1.574341e+000	4.781929e-001	1.152888e-001	0.000000e+000	11	1.000000e+014
8.211950e+002	1.573386e+000	4.736190e-001	1.162986e-001	0.000000e+000	12	1.000000e+014

gen = 11

8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	1	1.000000e+014
8.090730e+002	1.646564e+000	4.715103e-001	1.137176e-001	0.000000e+000	2	1.000000e+014
8.107120e+002	1.621007e+000	4.749129e-001	1.136978e-001	0.000000e+000	3	1.000000e+014
8.171830e+002	1.606572e+000	4.822578e-001	1.152055e-001	0.000000e+000	4	1.000000e+014
8.174810e+002	1.568765e+000	4.942893e-001	1.004023e-001	0.000000e+000	5	1.000000e+014
8.179120e+002	1.568711e+000	4.665894e-001	1.151629e-001	0.000000e+000	6	1.000000e+014
8.181110e+002	1.568711e+000	4.942893e-001	1.038840e-001	0.000000e+000	7	1.000000e+014
8.196600e+002	1.542186e+000	4.701670e-001	1.152998e-001	0.000000e+000	8	1.000000e+014
8.196860e+002	1.568711e+000	4.820314e-001	1.152920e-001	0.000000e+000	9	1.000000e+014
8.198390e+002	1.575493e+000	4.822036e-001	1.151629e-001	0.000000e+000	10	1.000000e+014
8.203190e+002	1.572897e+000	4.701670e-001	1.139022e-001	0.000000e+000	11	1.000000e+014
8.203550e+002	1.568711e+000	4.820314e-001	1.151629e-001	0.000000e+000	12	1.000000e+014

gen = 12

8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	1	1.000000e+014
8.090730e+002	1.646564e+000	4.715103e-001	1.137176e-001	0.000000e+000	2	1.000000e+014
8.104800e+002	1.606572e+000	4.822578e-001	1.152055e-001	0.000000e+000	3	1.000000e+014
8.107120e+002	1.621007e+000	4.749129e-001	1.136978e-001	0.000000e+000	4	1.000000e+014
8.144370e+002	1.644163e+000	4.731043e-001	1.004023e-001	0.000000e+000	5	1.000000e+014

8.150290e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	6	1.000000e+014
8.157620e+002	1.646564e+000	4.736424e-001	1.152046e-001	0.000000e+000	7	1.000000e+014
8.163630e+002	1.570849e+000	4.945301e-001	1.137176e-001	0.000000e+000	8	1.000000e+014
8.171830e+002	1.606572e+000	4.822578e-001	1.152055e-001	0.000000e+000	9	1.000000e+014
8.174810e+002	1.568765e+000	4.942893e-001	1.004023e-001	0.000000e+000	10	1.000000e+014
8.176500e+002	1.646564e+000	4.545208e-001	1.137176e-001	0.000000e+000	11	1.000000e+014
8.177400e+002	1.568765e+000	4.974805e-001	1.000487e-001	0.000000e+000	12	1.000000e+014
# gen = 13						
8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	1	1.000000e+014
8.090730e+002	1.646564e+000	4.715103e-001	1.137176e-001	0.000000e+000	2	1.000000e+014
8.104800e+002	1.606572e+000	4.822578e-001	1.152055e-001	0.000000e+000	3	1.000000e+014
8.107120e+002	1.621007e+000	4.749129e-001	1.136978e-001	0.000000e+000	4	1.000000e+014
8.128130e+002	1.606743e+000	4.986866e-001	1.145316e-001	0.000000e+000	5	1.000000e+014
8.140390e+002	1.647228e+000	4.733802e-001	1.152046e-001	0.000000e+000	6	1.000000e+014
8.141430e+002	1.646343e+000	4.738562e-001	1.147042e-001	0.000000e+000	7	1.000000e+014
8.142040e+002	1.646564e+000	4.764106e-001	1.137176e-001	0.000000e+000	8	1.000000e+014
8.143340e+002	1.649568e+000	4.715898e-001	1.142153e-001	0.000000e+000	9	1.000000e+014
8.143940e+002	1.644163e+000	4.714843e-001	1.002754e-001	0.000000e+000	10	1.000000e+014
8.143980e+002	1.646564e+000	4.731303e-001	1.140753e-001	0.000000e+000	11	1.000000e+014

8.144370e+002	1.644163e+000	4.731043e-001	1.004023e-001	0.000000e+000	12	1.000000e+014
# gen = 14						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	2	1.000000e+014
8.090730e+002	1.646564e+000	4.715103e-001	1.137176e-001	0.000000e+000	3	1.000000e+014
8.104800e+002	1.606572e+000	4.822578e-001	1.152055e-001	0.000000e+000	4	1.000000e+014
8.107120e+002	1.621007e+000	4.749129e-001	1.136978e-001	0.000000e+000	5	1.000000e+014
8.115040e+002	1.629567e+000	4.983005e-001	1.145316e-001	0.000000e+000	6	1.000000e+014
8.120470e+002	1.646564e+000	4.849092e-001	1.137176e-001	0.000000e+000	7	1.000000e+014
8.125850e+002	1.646564e+000	4.764106e-001	1.137176e-001	0.000000e+000	8	1.000000e+014
8.128130e+002	1.606743e+000	4.986866e-001	1.145316e-001	0.000000e+000	9	1.000000e+014
8.128870e+002	1.643188e+000	4.822578e-001	1.152055e-001	0.000000e+000	10	1.000000e+014
8.134460e+002	1.646564e+000	4.734307e-001	1.140753e-001	0.000000e+000	11	1.000000e+014
8.140390e+002	1.647228e+000	4.733802e-001	1.152046e-001	0.000000e+000	12	1.000000e+014
# gen = 15						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	2	1.000000e+014
8.090730e+002	1.646564e+000	4.715103e-001	1.137176e-001	0.000000e+000	3	1.000000e+014
8.098510e+002	1.646081e+000	4.983472e-001	1.146988e-001	0.000000e+000	4	1.000000e+014

8.100540e+002	1.629567e+000	4.982933e-001	1.129401e-001	0.000000e+000	5	1.000000e+014
8.102520e+002	1.646099e+000	4.986993e-001	1.139856e-001	0.000000e+000	6	1.000000e+014
8.104800e+002	1.606572e+000	4.822578e-001	1.152055e-001	0.000000e+000	7	1.000000e+014
8.107120e+002	1.621007e+000	4.749129e-001	1.136978e-001	0.000000e+000	8	1.000000e+014
8.115040e+002	1.629567e+000	4.983005e-001	1.145316e-001	0.000000e+000	9	1.000000e+014
8.118840e+002	1.646564e+000	4.849092e-001	1.137176e-001	0.000000e+000	10	1.000000e+014
8.120470e+002	1.646564e+000	4.849092e-001	1.137176e-001	0.000000e+000	11	1.000000e+014
8.125850e+002	1.646564e+000	4.764106e-001	1.137176e-001	0.000000e+000	12	1.000000e+014
# gen = 16						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
8.085800e+002	1.648397e+000	4.983472e-001	1.171892e-001	0.000000e+000	2	1.000000e+014
8.087040e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	3	1.000000e+014
8.087490e+002	1.646081e+000	4.986894e-001	1.174504e-001	0.000000e+000	4	1.000000e+014
8.087920e+002	1.646099e+000	4.983498e-001	1.146988e-001	0.000000e+000	5	1.000000e+014
8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	6	1.000000e+014
8.090730e+002	1.646564e+000	4.715103e-001	1.137176e-001	0.000000e+000	7	1.000000e+014
8.098240e+002	1.646564e+000	4.994001e-001	1.201308e-001	0.000000e+000	8	1.000000e+014
8.098510e+002	1.646081e+000	4.983472e-001	1.146988e-001	0.000000e+000	9	1.000000e+014
8.098570e+002	1.640761e+000	4.944912e-001	1.129401e-001	0.000000e+000	10	1.000000e+014

8.100540e+002	1.629567e+000	4.982933e-001	1.129401e-001	0.000000e+000	11	1.000000e+014
8.102520e+002	1.646099e+000	4.986993e-001	1.139856e-001	0.000000e+000	12	1.000000e+014
# gen = 17						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
8.083950e+002	1.649943e+000	4.986975e-001	1.146988e-001	0.000000e+000	2	1.000000e+014
8.084420e+002	1.649947e+000	4.986920e-001	1.147007e-001	0.000000e+000	3	1.000000e+014
8.085620e+002	1.649423e+000	4.983417e-001	1.106758e-001	0.000000e+000	4	1.000000e+014
8.085800e+002	1.648397e+000	4.983472e-001	1.171892e-001	0.000000e+000	5	1.000000e+014
8.085890e+002	1.646099e+000	4.991135e-001	1.146988e-001	0.000000e+000	6	1.000000e+014
8.086670e+002	1.646081e+000	4.989181e-001	1.122029e-001	0.000000e+000	7	1.000000e+014
8.087040e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	8	1.000000e+014
8.087150e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	9	1.000000e+014
8.087490e+002	1.646081e+000	4.986894e-001	1.174504e-001	0.000000e+000	10	1.000000e+014
8.087920e+002	1.646099e+000	4.983498e-001	1.146988e-001	0.000000e+000	11	1.000000e+014
8.088080e+002	1.646564e+000	4.736830e-001	1.137176e-001	0.000000e+000	12	1.000000e+014
# gen = 18						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
8.082480e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	2	1.000000e+014
8.083260e+002	1.649737e+000	4.987933e-001	1.174535e-001	0.000000e+000	3	1.000000e+014

8.083950e+002	1.649943e+000	4.986975e-001	1.146988e-001	0.000000e+000	4	1.000000e+014
8.084380e+002	1.649239e+000	4.986920e-001	1.170641e-001	0.000000e+000	5	1.000000e+014
8.084420e+002	1.649947e+000	4.986920e-001	1.147007e-001	0.000000e+000	6	1.000000e+014
8.084550e+002	1.649942e+000	4.983472e-001	1.124570e-001	0.000000e+000	7	1.000000e+014
8.084700e+002	1.649423e+000	4.983417e-001	1.110006e-001	0.000000e+000	8	1.000000e+014
8.085620e+002	1.649423e+000	4.983417e-001	1.106758e-001	0.000000e+000	9	1.000000e+014
8.085800e+002	1.648397e+000	4.983472e-001	1.171892e-001	0.000000e+000	10	1.000000e+014
8.085890e+002	1.646099e+000	4.991135e-001	1.146988e-001	0.000000e+000	11	1.000000e+014
8.085910e+002	1.649004e+000	4.983472e-001	1.146797e-001	0.000000e+000	12	1.000000e+014
# gen = 19						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
8.081650e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	2	1.000000e+014
8.082010e+002	1.649943e+000	4.996837e-001	1.146988e-001	0.000000e+000	3	1.000000e+014
8.082480e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	4	1.000000e+014
8.083260e+002	1.649737e+000	4.987933e-001	1.174535e-001	0.000000e+000	5	1.000000e+014
8.083950e+002	1.649945e+000	4.995135e-001	1.180278e-001	0.000000e+000	6	1.000000e+014
8.083950e+002	1.649943e+000	4.986975e-001	1.146988e-001	0.000000e+000	6	1.000000e+014
8.084380e+002	1.649239e+000	4.986920e-001	1.170641e-001	0.000000e+000	7	1.000000e+014
8.084420e+002	1.649947e+000	4.986920e-001	1.147007e-001	0.000000e+000	8	1.000000e+014

8.084550e+002	1.649942e+000	4.983472e-001	1.124570e-001	0.000000e+000	9	1.000000e+014
8.084700e+002	1.649423e+000	4.983417e-001	1.110006e-001	0.000000e+000	10	1.000000e+014
8.085620e+002	1.649423e+000	4.983417e-001	1.106758e-001	0.000000e+000	11	1.000000e+014
# gen = 20						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
8.081100e+002	1.649952e+000	4.999604e-001	1.131271e-001	0.000000e+000	2	1.000000e+014
8.081570e+002	1.649952e+000	4.996837e-001	1.120446e-001	0.000000e+000	3	1.000000e+014
8.081650e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	4	1.000000e+014
8.081680e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	5	1.000000e+014
8.082010e+002	1.649943e+000	4.996837e-001	1.146988e-001	0.000000e+000	6	1.000000e+014
8.082480e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	7	1.000000e+014
8.083040e+002	1.649943e+000	4.987598e-001	1.103024e-001	0.000000e+000	8	1.000000e+014
8.083260e+002	1.649737e+000	4.987933e-001	1.174535e-001	0.000000e+000	9	1.000000e+014
8.083670e+002	1.649947e+000	4.987301e-001	1.121522e-001	0.000000e+000	10	1.000000e+014
8.083820e+002	1.649737e+000	4.986986e-001	1.157307e-001	0.000000e+000	11	1.000000e+014
8.083950e+002	1.649943e+000	4.986975e-001	1.146988e-001	0.000000e+000	12	1.000000e+014
# gen = 21						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
8.081100e+002	1.649952e+000	4.999604e-001	1.131271e-001	0.000000e+000	2	1.000000e+014

8.081470e+002	1.649997e+000	4.996837e-001	1.146988e-001	0.000000e+000	3	1.000000e+014
8.081570e+002	1.649952e+000	4.996837e-001	1.120446e-001	0.000000e+000	4	1.000000e+014
8.081650e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	5	1.000000e+014
8.081680e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	6	1.000000e+014
8.082010e+002	1.649943e+000	4.996837e-001	1.146988e-001	0.000000e+000	7	1.000000e+014
8.082290e+002	1.649952e+000	4.997320e-001	1.146988e-001	0.000000e+000	8	1.000000e+014
8.082480e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	9	1.000000e+014
8.083040e+002	1.649943e+000	4.987598e-001	1.103024e-001	0.000000e+000	10	1.000000e+014
8.083260e+002	1.649737e+000	4.987933e-001	1.174535e-001	0.000000e+000	11	1.000000e+014
8.083670e+002	1.649967e+000	4.988973e-001	1.117786e-001	0.000000e+000	12	1.000000e+014
# gen = 22						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
8.081100e+002	1.649952e+000	4.999604e-001	1.131271e-001	0.000000e+000	2	1.000000e+014
8.081440e+002	1.649952e+000	4.996837e-001	1.232143e-001	0.000000e+000	3	1.000000e+014
8.081470e+002	1.649997e+000	4.996837e-001	1.146988e-001	0.000000e+000	4	1.000000e+014
8.081510e+002	1.649965e+000	4.997241e-001	1.109398e-001	0.000000e+000	5	1.000000e+014
8.081570e+002	1.649952e+000	4.996837e-001	1.120446e-001	0.000000e+000	6	1.000000e+014
8.081580e+002	1.649942e+000	4.996837e-001	1.120446e-001	0.000000e+000	7	1.000000e+014
8.081650e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	8	1.000000e+014

8.081680e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	9	1.000000e+014
8.082010e+002	1.649943e+000	4.996837e-001	1.146988e-001	0.000000e+000	10	1.000000e+014
8.082290e+002	1.649952e+000	4.997320e-001	1.146988e-001	0.000000e+000	11	1.000000e+014
8.082480e+002	1.649952e+000	4.996837e-001	1.146988e-001	0.000000e+000	12	1.000000e+014
# gen = 23						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014
8.081060e+002	1.649952e+000	4.999884e-001	1.155335e-001	0.000000e+000	2	1.000000e+014
8.081070e+002	1.649965e+000	4.999783e-001	1.109398e-001	0.000000e+000	3	1.000000e+014
8.081100e+002	1.649952e+000	4.999604e-001	1.131271e-001	0.000000e+000	4	1.000000e+014
8.081420e+002	1.649972e+000	4.996923e-001	1.230091e-001	0.000000e+000	5	1.000000e+014
8.081440e+002	1.649952e+000	4.996837e-001	1.120509e-001	0.000000e+000	6	1.000000e+014
8.081440e+002	1.649952e+000	4.996837e-001	1.232143e-001	0.000000e+000	6	1.000000e+014
8.081470e+002	1.649997e+000	4.996837e-001	1.146988e-001	0.000000e+000	7	1.000000e+014
8.081500e+002	1.649952e+000	4.997243e-001	1.109398e-001	0.000000e+000	8	1.000000e+014
8.081510e+002	1.649965e+000	4.997241e-001	1.109398e-001	0.000000e+000	9	1.000000e+014
8.081560e+002	1.649952e+000	4.996842e-001	1.146988e-001	0.000000e+000	10	1.000000e+014
8.081570e+002	1.649952e+000	4.996837e-001	1.120446e-001	0.000000e+000	11	1.000000e+014
# gen = 24						
8.030240e+002	1.646099e+000	4.986920e-001	1.146988e-001	0.000000e+000	1	1.000000e+014

8.081060e+002	1.649952e+000	4.999884e-001	1.155335e-001	0.000000e+000	2	1.000000e+014
8.081070e+002	1.649965e+000	4.999783e-001	1.109398e-001	0.000000e+000	3	1.000000e+014
8.081100e+002	1.649952e+000	4.999604e-001	1.131271e-001	0.000000e+000	4	1.000000e+014
8.081420e+002	1.649972e+000	4.996923e-001	1.230091e-001	0.000000e+000	5	1.000000e+014
8.081430e+002	1.649952e+000	4.996887e-001	1.163467e-001	0.000000e+000	6	1.000000e+014
8.081440e+002	1.649952e+000	4.996837e-001	1.232143e-001	0.000000e+000	7	1.000000e+014
8.081440e+002	1.649952e+000	4.996837e-001	1.120509e-001	0.000000e+000	7	1.000000e+014
8.081470e+002	1.649997e+000	4.996837e-001	1.146988e-001	0.000000e+000	8	1.000000e+014
8.081500e+002	1.649952e+000	4.997243e-001	1.109398e-001	0.000000e+000	9	1.000000e+014
8.081510e+002	1.649965e+000	4.997241e-001	1.109398e-001	0.000000e+000	10	1.000000e+014
8.081560e+002	1.649952e+000	4.996842e-001	1.146988e-001	0.000000e+000	11	1.000000e+014