

Rocket Flight Prediction

Final Report

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035

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Executive Summary.

We have flown our rocket e. The first flight was on a D12-5. This engine has a thrust of 12 Newton seconds and a burn time of 1.6 seconds. It was a beautiful flight! Apogee was estimated at about 600 feet. Our simulator gives the following data for the flight:

Maximum Altitude: 545.767 Feet

Maximum Velocity: 247.366 MPH

Next, we tried an F33-5J. It was the only other engine we had at the time, and it had a slow burn, so I was fairly unconcerned by damages caused by acceleration that was too rapid for the rocket. It took off beautifully, due a little more west than I hope, but that's solved with a little drive. The engine we used had been prepared some time ago, so there was some age in the O-rings inside of the engine. One of those slipped a little, and premature ejection occurred. When this happened, the parachute was shredded off, and the rocket came down on its side. A couple of fins were bent, but that was easily fixed. However, the simulator numbers are as follows:

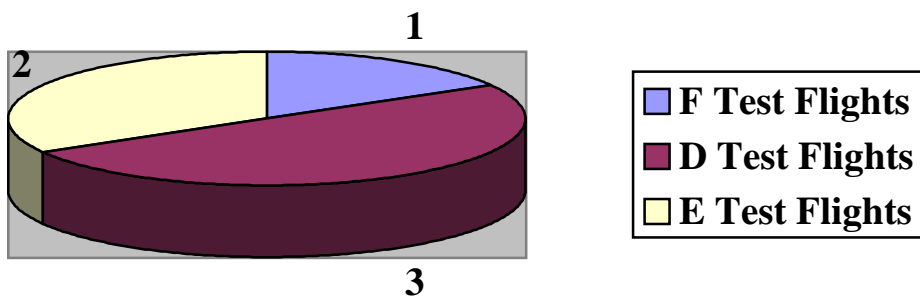
Maximum Altitude: 1705 Feet

Maximum Velocity: 553 MPH

Finally, the new Estes E 9-8 was given a try, with almost disastrous results. We came to the conclusion that the eight-second delay from burn out was a little longer than we hoped, but that is beside the point. The maximum altitude was estimated at about 800 feet. Our simulator gives the following data for this particular flight:

Maximum Altitude: 708.027 Feet

Maximum Velocity: 264.063 MPH



Problem

We have discovered that many of the model rocket simulators on the market today include one free little untold item: unlimited frustration! They just are not right!! We would like to change that. We plan on creating our own simulator. It will possibly include wind factors, landing plots, and launch angle compensations. There might even be graphical demonstrations.

Method Used:

We plan to solve our problem by trusting no one else to do it. We are building the rocket by hand, and creating our own simulator. Our rocket flies on 24mm engines (D-F) and has an unloaded weight of about six ounces. We are building our simulator in the programming language of C++. We gathered equations off of the web, and used motor databases off of the web also. Our program is enclosed, and is documented using comments.

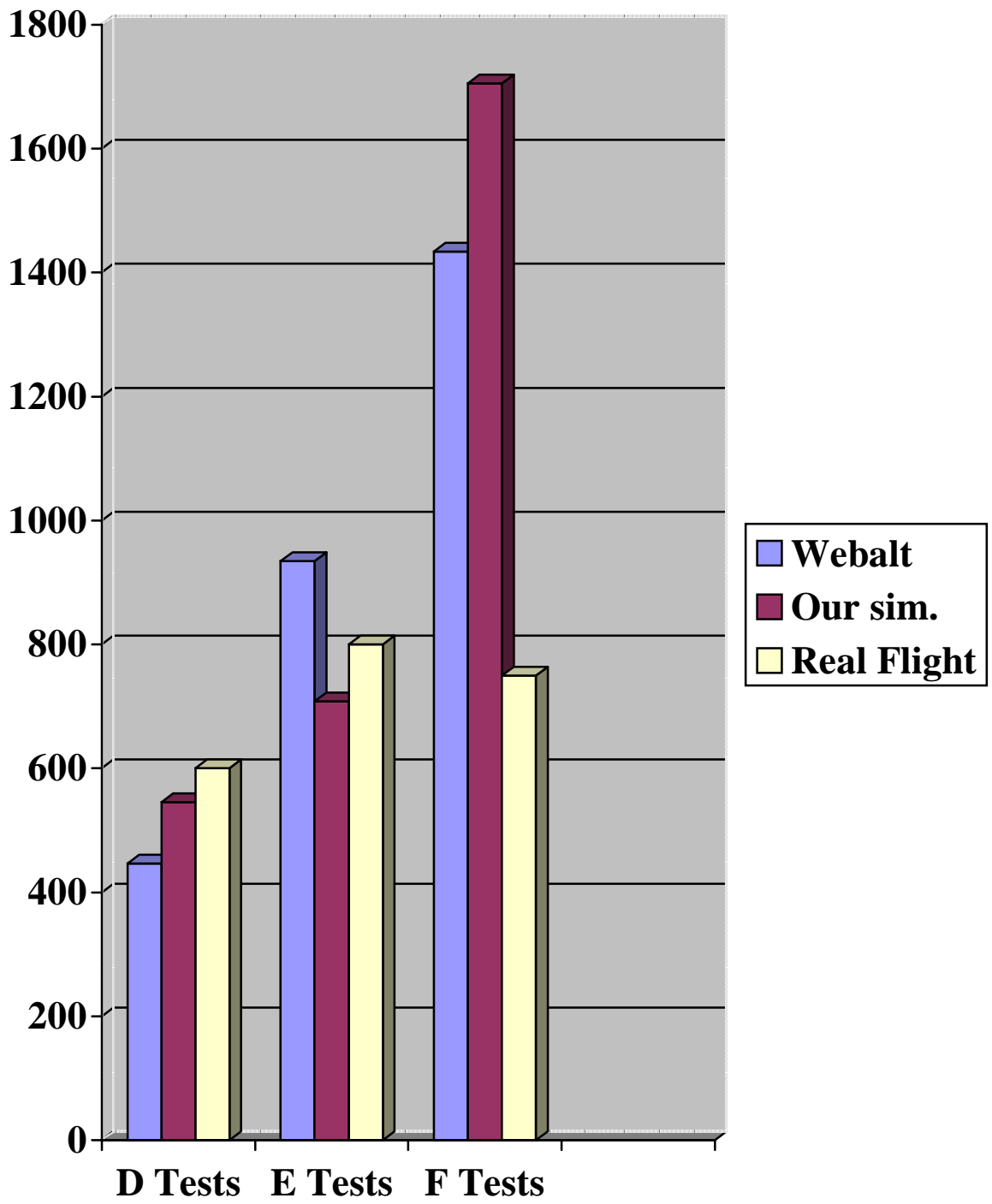
```
#include <iostream.h>//allows the user to view and input variables
#include <math.h>//enables various math functions to be used
double ln(double a);
double pow (double a);
int main()
{
double q=0, T=0, I=0, x=0, m=0, a=0, v=0, cd=0, rho=1.2, t=0, g=9.8, k=0, yb=0,
yc=0;//these are the variables we used

cout<<"What is the weight (in ounces) of your rocket?"<<endl;
cin>>m;
m=m/16/2.2;//converts the measurement to kilograms
cout<<"What is the diameter (in millimeters) of the rocket body tubing?"<<endl;
cin>>a;
a=a/25.4;//converts the measurement to inches
a=3.141592654*pow(.5*(a/12)*.3048);//computes the area of the rocket
cout<<"Please enter the coefficient of drag (usually 0.75)."<<endl;
cin>>cd;
cout<<"What is the impulse of the engine used?"<<endl;
cin>>I;
cout<<"What is the thrust of the engine used?"<<endl;
cin>>T;
k=.5*rho*cd*a;//Beginning of the initial equations
q=sqrt((T-m*g)/k);
x=2*k*q/m;
t=I/T;
v=q*(1-exp(-x*t))/(1+exp(-x*t));
yb=(-m/(2*k))*ln((T-m*g-k*pow(v))/(T-m*g));
yc=(+m/(2*k))*ln((m*g+k*pow(v))/(m*g));//End of equations
cout<<"Altitude at burnout is "<<yb*2.237<<" feet."<<endl;//Outputs
cout<<"Coasting distance is "<<yc*2.237<<" feet."<<endl;
cout<<"Maximum altitude is "<<2.237*(yb+yc)<<" feet."<<endl;
cout<<"The maximum velocity of the rocket is "<<v*3.281<<" mph."<<endl;
return (0);
}
double pow (double a)// provides the computer with a needed function unavailable to
the console
return (a*a);
}
```

```
double ln (double a) // provides the computer with a needed function unavailable to  
the console
```

```
{  
    return(log(a)/log(2.718281828));  
}
```

Results:



Conclusion:

We have come to the conclusion that our rocket simulator is not as accurate as we hoped it would be. As evident by the results, we have a lot of work to do. We can improve it by making the measurements easier to follow, and even creating a menu allowing a user to choose the measurements that they want. A GUI may also prove useful.

Software Used:

So far, we have used the following programs in our work: Linux, C++, Visual C++, Telnet, and the good ol' trusty Windows!

Most Significant Original Achievement:

I believe I am unsure of what the most significant achievement is, but, so far, I would have to say the maiden flight of the rocket. I had my doubts. Personally, I thought it was going to crash. Amid my doubts, however, it flew far, and it flew well.

Acknowledgements:

First, we would like to thank our mentors for all of the help they have done. Next, come the Fellowship of Las Cruces Area Rocketry Enthusiasts (F.L.A.R.E.) for all of the support that they have given us. Finally, we would like to thank Mr. McBride for giving us this huge project.

Here it is plain and simple:

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