Using wRASP

(A Short Primer)

Overview

wRASP (Rocket Altitude Simulation Program for Windows) is a PC program that simulates the flight of a model rocket in one dimension. The following paragraphs should help you become familiar with its operation.

Installation

The latest version of wRASP is available on the NAR Education CD, a diskette, or the wRASP web site:

http://www.wrasp.com

If you downloaded the wrasp95m.zip file, use Winzip or a similar program to unzip the files into a temporary directory (like C:\temp). If you downloaded the wrasp95m.exe file, move it to a temporary directory and run it. Once the files are extracted in either case, run the setup.exe program in the temporary directory.

If you have a diskette, locate and run setup.exe on the A:\ drive.

Running setup.exe will launch the familiar InstallShield®Wizard which will install the wRASP program. If no changes are made, the following installations will occur:

> wRASP files will be installed in C:\Program Files\C & S Software\wRASP
> two files (BC520rtt.dll and Bwcc.dll) will be placed in C:\windows\system
> a wRASP folder will be added to Start\Programs
> uninstall information will be added and is available from the control panel

Uninstalling wRASP

If you installed wRASP using InstallShield®, select Start/Settings/Control Panel and then select the “Add/Remove Programs” icon. Now select wRASP from the list of programs and then the “Add/Remove” button. You may elect to keep the Borland DLL files since other programs might use them.

If you had run wRASP, some output and log files were generated and must be deleted manually after Uninstall runs. Using Windows Explorer, delete the “C:\Program Files\C & S Software” directory or whatever directory was used to install wRASP.

Finally, manually delete the wRASP configuration file, “wrasp.ini” in the C:\WINDOWS directory.

Running wRASP

wRASP uses the familiar Windows Graphical User Interface (GUI) that includes menus and mouse operations. However, someone new to rocketry may not know how to use it. This section should make wRASP operation “old hat”.

Start the program by clicking on “Start” at the bottom of the Windows screen. Next, click on “Programs”. Locate the “wRASP” folder and then on the wRASP icon. The program should then load and be ready for use.

When first loaded, wRASP contains enough data to launch a rocket. The data is from an Estes Alpha model rocket kit and uses an Estes A8 rocket motor. The launch conditions (environment) are for that elusive “standard” day at sea level. (how to change all these things will be covered in the following sections).

Without changing anything, click on the “Launch” menu item near the top left of the screen. Another way is to hold the “Alt” key and press the “L” key (shown by the L in the menu). This action launches the rocket described in the data. The data items will change and two graph lines will appear. Then everything will stop.

Here is what the different sections mean:

The data box in the upper left contains the basic rocket information. The kit manufacturer supplies the body tube diameter and typical empty weight. The motor manufacturer supplies the motor weight and its thrust data curve (shown in the lower right corner). The coefficient of drag, C_D, is the wRASP initial guess and is the most likely candidate to change. This value describes how “aerodynamic” the rocket is.

The environmental conditions appear in the box in the lower center of the screen. This data can be changed to match your location and climate. Sometimes this can drastically affect how the rocket flies.

The box in the center of the screen shows the conditions at the end of the flight. The difference between the rocket weight here and the data in the upper left corner shows how much propellant was burned during the flight. (Press “Launch” again to watch this number change).

The box in the lower left shows flight parameter maximums during the flight. These help determine whether a flight will be a safe flight or not. Problems occur if a very high acceleration is indicated or very high speed (near the speed of sound or Mach 1). The altitude may also be too low, causing the ejection charge to not function. Also, the rocket velocity at the top of the launch rod may be too low, causing the rocket to not fly straight up and/or become unstable.

The graphs in the upper right box help explain what happened during the flight. The red/black curve is the rocket altitude and the blue curve is the rocket velocity (absolute value – positive going up and negative going down). The red section of the altitude curve indicates that the motor is burning and providing thrust.

There are several vertical lines that point out events that occur:

bo – motor **b**urn**o**ut – this is where the motor propellant has all been burned up. Notice that the velocity drops off after this event as gravity and drag force become the only forces acting on the rocket.

apo – **apo**gee – the point of maximum altitude and also the point where the velocity is zero and is in the process of going positive to negative.

d0,d3,d5 – ejection **d**elay times – these are the points in the flight where the ejection charges occur. The table in the center of the right side of the screen displays the rocket velocities at these times. This can be used to pick the best available ejection charge for the flight – the one closest to apogee and closest to zero velocity. Note – for this motor, the d0 (zero delay) is no longer available and was typically used as a booster motor. The d5 motor has also been recently discontinued, though some are still available.

So, after launching an Estes Alpha with an Estes A8 motor on the coast on a “perfect” day, we can determine that the rocket will go approximately 256 feet up, reaching a speed of 137 feet per second, and that an ejection delay of 3 seconds is probably the best to use (although 5 seconds would probably work and eject closer to the ground – for a shorter walk). We can also see that the motor will burn for almost half a second and that the rocket will be moving the fastest right before the motor burns out.

As a caveat, the actual motor and rocket combination can have flights that vary from this due to construction and individual motor performance. Actual flights can be used to get a better estimate of the C_D value and therefore produce more accurate simulations.

Use the mouse and click on the curve at the point of apogee. The altitude value on the left side of the curve box, the velocity value on the right side, and the time at the bottom will all change to reflect the conditions at that point of the flight.

Click on the curve at the “d3” delay point – this should be about 3.5 seconds into the flight at an altitude of 151 feet and a velocity of 17 feet/second.

If you are a science teacher, you may want to look at all these data values in their metric equivalents. To do that, select the “Options” and then “Units and Stuff”. Now click on the units desired for the different measures. Interestingly, rocketeers use the metric “newtons” to measure thrust while using English units for everything else.

Selections of units and other options will be remembered and used the next time wRASP is run, thus saving setup time.

wRASP has many more options and some, but not all, will be described in the next two sections. For more detailed information, select the “Help” menu item and then “Running wRASP”.

Typical Use

Of course, the location, rocket kit and motor will be different. Let’s assume that we have just purchased a Pratt Hobbies Super 6 model rocket from the Internet and have a Quest B6-4 motor. We will fly somewhere near Windom, Texas (900 feet mean-sea-level – MSL) on a balmy 85°F day. Here is how it is done:

First, set the environment: Select the “Data” menu item and then “Environment”. Enter 900 into the base altitude data box. Click on “ICAO” standard day and then enter 85 degrees into the temperature box. Click “recalculate” and notice that the density and speed-of-sound constants change. Also notice that the atmosphere model was automatically changed to “Hot Day”. The pressure will be left the same, although it could be changed as well.

Next, load the rocket kit data: Select the “File” menu item and then :”Browse Rocket Database”. A dialog box will appear. Scroll down the list of manufacturers in the box on the left until “PH Pratt Hobbies” is found – click on that line to select it. The kit box on the right will reposition to the first Pratt kit – scroll down and find and select the “Super 6”. Notice that information about the kit will appear. Select “Load Data” and all this information will be loaded to the main screen.

Oops, if you looked at the list of recommended motors for the Super 6, it only lists A-power motors and we are planning to use a B6-4. Better build the kit as strong as possible. (The kit flies on B and C motors nicely, though). This list is just a guide, and may be incomplete.

Let’s assume we will fly the rocket kit unpainted and that a higher C_D probably ought to be used, say 0.7. Change it by selecting the “Data” menu and then “Rocket”. Change the C_D value to 0.7 (it should already be highlighted). None of the other items will change but note that it is here that a multi-stage rocket’s data is entered. When ready, select “OK”.

Finally, change the motor from the A8 used previously: Select “Data” and “Stage 1” – another dialog box will appear. There are lots of motors to choose from – they are listed by the “power” letter. The Estes A8 should already be selected. Scroll down and select the Quest B6 (B6 QU). The data will change. Notice that “Maximum Body Diameter” is listed. This is to clue you when a motor is larger that the diameter of the rocket data already loaded. wRASP generates a warning but allows you to simulate the flight anyway (a “fantasy” flight).

Now click “Show Data” – a small box with the thrust curve for the motor will appear. If this is not what you want, you can close the data box and try something else. We want the Quest B6-4, so just select “OK”.

All of the data should now be visible on the main wRASP screen. Look it over and select “Launch” when you are ready. The curves will appear and it looks like the rocket will go to almost 960 feet in 6.3 seconds. Since the 4 second delay will eject prior to apogee, it probably will not get that high. Clicking on the d4 point shows 917 feet – quite a bit higher than the Alpha on an A8!

You can now easily try other motors by selecting them using the “Data/Stage 1” menu items and then selecting “Launch”.

Advanced Use

The wRASP program includes a database of rocket kits and motors. However, the data needed to represent a rocket kit is usually available in the catalog or on the kit packaging material. The following data is needed to calculate a basic predicted altitude:

Rocket empty weight, in ounces
Maximum diameter of the body tube, in inches
An initial guesstimate of the coefficient of drag, like 0.7
Motor type

This data is entered using the “Data” menu – “Rocket”, “Stage 1/2/3”, and “Environment”. Once the proper data is entered, the “configuration” can be saved for future use. Use the “File” menu to save and load these rocket configurations by a name that you will easily recognize. One advantage to this method is that all of the data is saved, including the C_D and motor selections. Saved configuration files have a “.rsp” suffix. Since wRASP associates this suffix to itself when it is installed, double clicking on a saved configuration file will run wRASP and load the file, ready to launch.

Several kit configuration files are saved as examples. Using the “File” and “Load Rocket Config”, load the Estes Comanche 3 file. Notice that the 3-stage rocket has three different C_D values, along with different motors for each stage. Launch the rocket for an example of a multi-stage flight – this configuration is the one Estes specifies for maximum altitude.

Troubleshooting wRASP

wRASP has been installed on Windows 3.1, 95, 98, and NT. It has not been installed on Windows 2000, Me, or XP. However, it is expected to work on these versions as well.

The most common problem is an older version of the BWcc.dll file in the C:\WINDOWS directory which overrides the one in the C:\WINDOWS\SYSTEM directory that wRASP installs. Just delete the file in the C:\WINDOWS directory. This problem is evident when wRASP will run (and launch) but no data items can be changed. The “Help” menu also has additional troubleshooting information.

Additional Help

The wRASP “Help” menu is the best location for additional information on the workings of wRASP.