

## Editing Thrust Curves

This chapter describes the operations of creating, saving, and altering thrust-time profiles which are used to define burn events in CompuRoc simulations. The thrust curve editing process is quite intuitive in its use of the Macintosh mouse-driven interface, and most Mac users will find it very easy to master.

As mentioned earlier in the introductory chapter, the thrust editing mode of CompuRoc can be called up from the desktop in two ways. Either opening a thrust curve document or opening CompuRoc itself while holding down the option key will cause the thrust curve windows to be displayed. If CompuRoc is already loaded, the thrust editing mode is accessible via two items under the 'File' menu.

ig. 7 - Thrust Curve Editing Window

After the current simulation (if any) is closed, the following two 'File' menu items become activated:

### New Thrust Curve

Selecting this item opens a new (blank) thrust curve initially named 'Untitled'. From this point the new thrust curve may be entered.

### OpenThrust Curve

Selecting this item opens a previously saved thrust curve document. The document to be opened is selected via the standard Macintosh file selection dialog. The thrust curve windows (described below) are displayed containing the selected engine data. From this point the thrust curve may be edited. Equivalent : from keyboard, type  $\hat{\text{C}}\sim$  -T.

The 'Close' or 'Quit' items in the 'File' menu or the window "close box" are used in the standard way to close an open thrust curve file.

## • Thrust Curve Windows

When CompuRoc is opened in thrust editing mode, two windows are displayed, the editing window, and the statistics window. Each of these windows is moveable (by dragging the title bar), and either may be activated (brought to the front) by clicking on any part. The editing window may be re-sized in the usual Macintosh manner, using either the 'zoom box' in the upper right corner or by dragging the 'grow box' in the lower right. Figure 7 shows a screen image of CompuRoc in thrust mode with the editing window active. This window includes vertical and horizontal scroll bars, which enable the user to view and edit a region larger than the size of the window. These scroll bars are used in the standard manner also familiar from most Macintosh applications.

The main content of the editing window is a graph of thrust versus time on which is displayed the currently open thrust curve. Thrust curves are created or edited by directly "drawing" on the graph using the mouse (more on this later). The vertical axis is measured in Newtons (N) of force, and using the scroll bars, ranges from zero to 2000 N. The horizontal (time) axis ranges from zero to 10 seconds, and the time resolution (one pixel on the screen) is 0.01 s.

When the cursor (pointer) is positioned over the graph area of the active editing window, it changes to a '+' shape. This is the curve-drawing cursor. Elsewhere on the screen the pointer reverts to its usual form and function.

The statistics window, shown in Figure 8, is used to display numerical information

about the current thrust curve. The total impulse (Newton-seconds), average thrust (Newtons), and thrust duration (seconds) are displayed here and continuously updated during the editing process.

In addition to these numerical displays, the statistics window contains two editable data entry boxes which are used to specify (or change) the total initial engine mass and the propellant mass used by CompuRoc in the course of a simulation. These mass values are entered in grams and the latter is assumed to "burn off" during flight at a rate proportional to the instantaneous thrust of the particular engine. The engine masses (as well as the thrust) are multiplied by the cluster factor used in linking a thrust curve to a simulation (see chapter on building simulations).

ig. 8 - Thrust Curve Statistics Window

## • Thrust Curve Drawing

Drawing a thrust curve profile in CompuRoc uses "point and click" methods familiar to users of MacPaint and other Macintosh graphical applications.

"Dragging" the mouse over the graph while the mouse button is depressed draws a curve segment in the editing window. There are a couple of restrictions however, in how these curves can be drawn. First, the thrust curve must be a single-valued function, meaning that there can be only one thrust value at any instant of time. If the user tries to draw a curve that "doubles back" on itself, CompuRoc displays only the last drawn value for each instant. Along the same lines, drawing over a preexisting curve replaces the original curve with the new curve, over the range that they overlap.

While in principle, this is all the user needs to generate thrust curves, there are a few "hidden" features that make the job easier and more accurate. The first such feature is a part of the Macintosh system, rather than of CompuRoc itself. The 'Control Panel' desk accessory can be used to adjust the mouse tracking speed for best drawing accuracy. Many users will find that using the 'Slow' or 'Very Slow' settings will improve their ability to accurately control their curve drawing.

There are two "keyboard constraint" options which are used to draw straight line segments while curve editing. In this discussion, a "drawing operation" will refer to the drawing action that occurs between one mouse "button down" user action and the following "button up" event. If the shift key is depressed when starting a drawing operation, the drawing is constrained to remain on a level horizontal line through the starting point. The net effect of the operation is an exactly horizontal line between the starting and ending time positions. If the option key is down while drawing, the operation is constrained to a sloping line segment connecting the starting and ending points of the operation. These two techniques are extremely useful for precise "hand drawing" of curves.

A final helpful option for generating thrust curves is the ability to read in thrust histories from externally generated text files. This option is described in detail in the following chapter on 'Exporting and Importing Text Files'.