Table of Contents for

Hubble Space Telescope

by Sci-Vision

The Main Menu

Technical Items

Introduction

Hubble Space Telescope is a program which provides astronomical simulations the same way as seen in a planetarium. Hubble will show the past, present and future skies as viewed from anywhere on Earth. The program can display the positions (with real time updating) of the planets and comets as they orbit our Sun. It can also calculate specific data about celestial bodies and present this data in numeric form. Hubble will even display the moons of Jupiter as they orbit their planet.

Program options allow you to select the date / time to view, the direction of view, your latitude and longitude on Earth, and much more. Using the display updating parameters Hubble can display a complete day's movement of the heavens, demonstrate the retrograde motion of the planets, or one of many other astronomical simulations.

To introduce you to the wide range of features offered by Hubble, several demonstation setup have been supplied with the program. To run these demonstrations, use the <u>Restore Setup</u> option under the <u>F</u>ile option on the <u>main menubar</u>. This will allow you to load pre-configured setups which exercise different aspects of the program and will give you ideas on how you can create you own simulations using the various configuration settings.

System Requirements

Hubble was designed to run under Microsoft Windows 3.0 (or better).   The system should have an EGA (or better) monitor.   Although not required, a system equipped with a math co-processor is highly recommended.   Due to the highly math intensive nature of this program, running Hubble on a system equipped with a math co-processor can improve processing time by 10X.

Graphical Displays

The buttons in this section select the Graphical-Displays.   These are the displays which show astronomical information graphically.   Graphical-Display buttons are located in the upper half of the top section of the Main Menu.   The displays that are available are:

Horizon
Zenith
Star Map
Relative Sizes
Jupiter's Moons
Solar Orbits

Data Displays

The buttons in this section select the Data-Displays.   These are the displays which show astronomical information in numeric form.   Data-Display buttons are located in the lower half of the top section of the Main Menu.   The displays that are available are:

<u>Positions</u>
<u>Rise/Set Times</u>
<u>Distances</u>

Setup Menus

The Setup Menus allow user customization of program parameters.   The following menus are available to configure different aspects of the program. The Setup Menus make up the lower portion of the Main Menu.

       Planet Selection
       Star Magnitudes
       StarMap Boundaries
       Zenith View Angle
       Time Updating
       User's Location on Earth
       Horizon View Direction
       Leave Trails

NOTE: To save changes to these parameters, the Save Setup feature must be used.

Menu Bar

The Main MenuBar   provides additional program configuration options.   These options include:

Saving Program Configuration
Restoring Program Configuration

Type of DayLight Savings Time correction to use.
Use of English or Metric units on measurements.

NOTE: To save changes to these parameters, the Save Setup feature must be used.

Horizon Display

The Horizon display shows the sky as seen from Earth when looking in a <u>specified direction</u> at a <u>specific time of day</u> from a <u>specified location on Earth</u>

The left side of the display is what would be seen looking over your left shoulder as is the right side over your right shoulder.   The top of the display shows what you would see directly over your head. Because of the transformation from a normal 3-dimensional sky to the 2-dimensional display screen, the distortion increases as you approach the edges of the arc. Another way to visualize what the display is representing is; image you are sitting in the middle of the planetarium.   You see in front of you half of the planetarium dome.   The difference is that at the planetarium, your field of view would not be large enough to see the complete half dome all at one time. With the program, the complete half dome is compressed onto the flat screen.

The View Direction can be changed by pressing the **Left or Right arrow** buttons. This has the same effect as changing the <u>view direction setup</u> from the main menu.

Refer to the following for additional configuration of this screen:

<u>Leave Trails</u>
<u>Time Updating</u>
<u>Auto / Update Buttons</u>
<u>Magnitude Setup</u>
<u>Planet Selection</u>
<u>Object Identification</u>

Zenith Display

The Zenith display shows the sky as seen from Earth when looking directly over head at a <u>given time of day</u> from a <u>specified location on Earth</u>.   The top of the displayed circle represents the compass direction of North, the bottom of the screen is South, right is to the West and the left side of the circle is toward the East horizon. Another way to visualize what this display is depicting is; if you were to lay on you back and look up at the sky, this is what you would see on the display.   Keep in mind that distortion increases as you approach the edges.

Refer to the following for additional configuration of this screen:

<u>Zenith View Angle</u>
<u>Leave Trails</u>
<u>Zoom   In / Out</u>
<u>Time Updating</u>
<u>Auto / Update Buttons</u>
<u>Planet Selection</u>
<u>Object Identification</u>

Star Map Display

This display is used to create a Star Map located at given <u>Right Ascension</u> / <u>Declination</u> coordinates.   All objects within the boundaries of the window are displayed.   This display is useful for zooming in on a region of the sky, the same way a telescope would be able to zoom in on a particular area of the sky.   The Star Map produces a display similar to those found in astronomy handbooks.

The initial center and width of the display are determined   from the values entered into the <u>StarMap setup menu</u>. The width value is interpreted as the amount of right ascension covered from the left side of the window to the right.   The amount of declination covered in he display is calculated automatically to give the correct scaling.

While viewing the star map, the center of the display can be shifted in Right Ascension using the **Left / Right arrow buttons**.   The display can be shifted in declination using the **vertical scroll bar** on the right side of the screen.

Refer to the following for additional configuration of this screen:

<u>Leave Trails</u>
<u>Zoom   In / Out</u>
<u>Time Updating</u>
<u>Auto / Update Buttons</u>
<u>Magnitude Setup</u>
<u>Planet Selection</u>
<u>Object Identification</u>

Relative Sizes Display

The Relative Sizes display allows the user to visualize the difference in size between any two planets, stars, or moons.   The display draws the two bodies to relative scaled size and labels them at the bottom of the display.   Above each of the bodies is their diameter in the user's selected <u>Unit of Measure</u>.   The numeric values which appear between the two bodies show the ratio of the size of the larger to the smaller one.

To change either the left or right body from the one currently displayed, pressing the **Select Object** button will provided a list of the bodies which may be displayed.   Check the radio button next to the object and press OK.   The old body will be replaced by the newly selected one.

Note: If one of the bodies is not visible, this is because the size difference was beyond the resolution of the display.

Jupiter's Moons Display

The Jupiter's Moon Display shows the position of the four   major moons of Jupiter as they orbit their planet.   Using the Up / Down buttons the view perspective can be changed.   Pressing the **Up button** moves the perspective of the observer up from the plane of the moon's orbits toward the North Pole of Jupiter.   Pressing the **Down button** moves the observers perspective back down toward the plane of moon's orbits.   The **Orbits button** selects whether the orbital paths of the moons will be drawn.

Refer to the following for additional configuration of this screen:

> Leave Trails
> Zoom   In / Out
> Time Updating
> Auto / Update Buttons

Solar Orbits Display

This display shows the position of the planets and comets as they orbit the Sun.   The view is from above the plane of the solar system with planets moving counter clockwise around the Sun.

The 'Display Radius' value shown in the upper left corner of the screen is the number of <u>AUs</u> from the sun to the left or right edge of the screen.

Refer to the following for additional configuration of this screen:

> <u>Leave Trails</u>
> <u>Zoom   In / Out</u>
> <u>Time Updating</u>
> <u>Auto / Update Buttons</u>
> <u>Object Identification</u>

Positions Display

This display provides numerical information about the planets, Sun and Moon's position with respect to Earth.   The <u>Right Ascension</u>, <u>Declination</u>, <u>Altitude</u> and <u>Azimuth</u> are displayed for each object.

In the upper left hand corner of the screen two date/times are displayed.   The upper date/time gives the <u>Local Time</u>.   The lower time is the <u>GMT</u>.

Refer to the following for additional configuration of this screen:

<u>Time Updating</u>
<u>Auto / Update Buttons</u>
<u>Planet Selection</u>

Rise/Set Times Display

This display provides numerical information about Rise and Set times of the planets, Sun and Moon.

The display show the rise and set time of each of the objects and the total time the object is above the horizon.   The 'Up' column displays a carrot   '^' if the object is above the horizon at the displayed time.   The display also shows the Phase and Magnitude of each object.   The calculations for rise and set times currently don't adjust for parallax or atmospheric refraction. Thus, times can vary by a couple of minutes from the 'true' rise and set times.

In the upper left hand corner of the screen two date/times are displayed.   The upper date/time gives the Local Time.   The lower time is the GMT.

Refer to the following for additional configuration of this screen:

>   Time Updating
>   Auto / Update Buttons
>   Planet Selection

Distances Display

This display provides numerical information about Distances of the planets, Sun and Moon's

The display show the distance of each of the objects from both the Earth and the Sun.   The distances are measured in both <u>AUs</u>   and in millions Miles (or Kilometers), depending on the setting of <u>unit of measure</u>.

Refer to the following for additional configuration of this screen:

<u>Time Updating</u>
<u>Auto / Update Buttons</u>
<u>Planet Selection</u>

Planet Selection Menu

This menu allows the selection of which planets will be displayed in both the <u>graphical displays</u>and the <u>data displays</u>.   If the object is checked, it will be displayed otherwise it will not. The check boxes for the Sun, Moon and Comets have the same effect.

NOTE: To save changes to these parameters, the <u>Save Setup</u> feature must be used.

Star Magnitude Menu

This menu is used to configure how stars will be displayed when viewing the <u>Horizon</u>, <u>Zenith</u> and <u>Star Map</u> displays.   Stars can be turned On or Off and the viewable <u>magnitude</u> limits can be also be adjusted.

Show Stars   selects whether or not stars are displayed on the Horizon, Zenith and Sky Map displays. (***Note**: Our Sun is not considered to be in   the set of stars but is treated more like a planet in this instance*)

Enlarge Stars   If set, brighter stars will be drawn larger than dimmer stars. This same setting also causes comets to be drawn as a cross.   Although this selection creates stars which are not true to size, it may be helpful   for Non-EGA/VGA monitors which can not   show different star intensities with color.

The intensity cutoff values are used for determining which stars are displayed and to determine plotting size when 'enlarged stars' is set.   These values allow you to control how the stars are displayed, tailoring the intensities to simulate the sky as it can actually be seen at your location, considering the amount of ambient city lights.

First Cutoff   Stars with magnitudes between *Minus Infinity* and the First Cutoff are displayed in a high intensity white, and in the largest size (see 'enlarged stars' above').

Second Cutoff Stars with magnitudes between the First Cutoff and the Second Cutoff are displayed in a medium intensity white and a medium size.

Third Cutoff Stars with magnitudes between the Second Cutoff and the Third Cutoff are displayed in a low intensity white and a small size.

Stars with magnitudes dimmer than the Third Cutoff are NOT displayed at all.   Although not explicitly controlled, Deep Space Objects such as Nebulas and Galaxies are controlled by the same magnitude/size settings as the stars.

NOTE: To save changes to these parameters, the <u>Save Setup</u> feature must be used.

StarMap Boundaries Menu

The values entered here define the location about which the Star Map will be centered and how much Right Ascension will be included between the left and the right edges of the window.

Center Right Ascension defines the value of right ascension that the star map display will be centered on, left to right

Center Declination   defines the value of the Declination that the star map display will be centered on, top to bottom

Width Right Ascension   defines the amount of   right ascension that will be displayed between the left and right edges of the star map display.

NOTE: To save changes to these parameters, the Save Setup feature must be used.

Zenith View Angle Menu

Zenith View Angle defines the lowest <u>Altitude</u> that an   object can currently be at, and still appear on the <u>Zenith Display</u>.   The larger the value, the narrower the imaginary cone of view above you will be.   A value of zero provides a fish eye view of the sky looking up, including the whole horizon around the edge of the circle.

NOTE: To save changes to these parameters, the <u>Save Setup</u> feature must be used.

Time Updating Menu

This menu is used to define the time for which the displays are drawn and to define how much time each consecutive display is advanced.

Update Mode- If   REAL TIME   mode is selected, the system's clock is used to derive the time for each consecutive display.   The value of Update Rate is ignored in REAL TIME mode. The value of User Defined time is also ignored.   Values other than REAL TIME use the User Defined Time described below.   Incrementing each consecutive display is done by adding the Update Rate to the displayed time according to the display mode.

Some terms that may not be familar are:
A *Sidereal Day* is one revolution of the Earth with reference to the stars (instead of the Sun).   It is approximately equal to 23 hours and 56 minutes.
A *Lunar Day* is one revolution of the Earth with reference to the Moon (instead of the Sun).   It is approximately equal to 24 hours and 50 minutes.

Update Rate defines how much time is added to each consecutive display. It is used whenever the is not set to REAL TIME. See Update Mode definition above.

Month,Day,Year, Hour,Minute,Second are used to set the User Defined start time for update modes other than the REAL TIME mode.   **Note,** the start time is specified in <u>Local Time</u>, including <u>Daylight Savings Time</u> when applicable.

NOTE: To save changes to these parameters, the <u>Save Setup</u> feature must be used.

Observer Location Menu

This menu allows you to define where you are located on Earth.   This information is used only on the following screens:

>   Horizon
>   Zenith
>   Positions
>   Rise/Set Times

Longitude is the observer's longitude on Earth.
West of the Prime Meridian is **positive** and East is **negative**.

>   Example: Mpls, Mn. is approximately   +90
>   Columbus, Ohio is approx.   +80

Latitude is the observer's latitude on Earth.   North of the Equator is **positive** and South is **negative**.

>   Example: Mpls, Mn. is approximately   +45
>   Columbus, Ohio is approx.   +40

Time Zone describes the difference between GMT and Local Time.
>   Example: USA Central Time is a   +6.
>   USA Eastern Time is a   +5.
>   New Zealand is a   -12.

If you do not know your longitude / latitude / time zone, you may press the Locator Button for help in determining these values.

NOTE: To save changes to these parameters, the Save Setup feature must be used.

City Lookup Menu

This menu aids you in determining your Longitude / Latitude and Time Zone.   Pick your state (or Country) from the drop down list at the top of the menu.   Then press the **List Cities Button**. A list of cities in that state (or Country) will be presented.   Pick your city (or the closest one to you) and click on it with the mouse.   Once a selection is highlighted, press the **OK Button.** This will fill the location values on the Location Setup Menu.

Horizon View Direction Menu

View Direction   is used to select which direction you are looking when using the <u>Horizon Display</u>.   View Direction is the same as is measured using a common magnetic compass.   The full 360 degree circle is broken into eight distinct directions:

North
North East
East
South East
South
South West
West
North West.

NOTE: To save changes to these parameters, the <u>Save Setup</u> feature must be used.

Leave Trails Menu

Leave Trails selects whether the bodies on the <u>graphical displays</u> leave a trail behind themselves as they move.   This is useful for examining the paths they are following.

When Leave Trails is selected, the current time is copied to the upper left corner of the window. This shows the time that the bodies started leaving trails and is useful for seeing how much time passed to generate the trail paths showing on the display.

NOTE: To save changes to these parameters, the <u>Save Setup</u> feature must be used.

Save Setup

The **Save Setup** feature allows you to save the changes you have made to the program with the various setup menus. This is useful for creating multiple configurations of the program, each designed to view different events.   When saving setup files, it is recommended that the **.MNU** extension be used for each setup file created.   When saving a setup file, you may type in a new setup file name or choose one from the list box by single clicking on a filename.   The description field is used to give a description, up to 500 characters, explaining the intent of the setup.   If you are choosing a setup file from the list box, you are allowed to edit the description which was filled by the single click on the name.

The setup file **DEFAULT.MNU** has a special purpose.   When Hubble initializes it looks for the existence of this file.   If it is found, the setup file is used to initialize the program.   This is very useful for the purpose of saving the parameters that specify your location on Earth.

The Restore Setup feature restores the configuration files that are saved.

Restore Setup

Restore Setup   does the opposite of <u>Save Setup</u>.   Restoring a setup file will change the program configuration values to those that were defined when the setup file was created.

To restore a configuration file, either type in a file name (with the .MNU extension) or choose one of the setup files displayed in the list box by single clicking on it.   When a file name in the list box is clicked, the description for that setup is displayed.

Auto / Update Buttons

The **Display Updating Buttons** are composed of 4 separate buttons. The function of all 4 buttons are to change the time and repaint the display according to the new time.   These buttons are:

Auto (+)   Starts the program *incrementing* automatically by the Update Mode and Update Rate.   The display continues to increment the time until the **Stop** button is pressed.
Auto (-)   Does the same as Auto (+) but *decrements* the time by the Update Mode and Update Rate.   The display continues to decrement the time until the **Stop** button is pressed.

Update (+)   *Increments* the time *once* by the Update Mode and Update Rate.
Update (-)   *Decrements* the time *once* by the Update Mode and Update Rate.

NOTES:
The Auto buttons become the Stop buttons when they are pressed.   They then return to being the Auto buttons when the Stop button is pressed.
During Auto Updating, some of the buttons are grayed, indicating that they are not available until the Stop button is pressed.
If the current Update Mode is the REAL TIME mode.   The Auto (-) and Update (-) buttons are not available and will be grayed.
During Auto Updating you will be unable to use the 'Object Identification' feature.

See the Time Updating Menu for more information on how time is incremented.

Object Identification

When in the Horizon, Zenith, StarMap or Solar Orbits displays , you have the option to use the mouse point to select an object on the screen for identification.   The object to be identified is selected using the '*gun sight*' cursor.   This is the special cursor which appears when the mouse pointer is moved over the black portion of the display when it supports this feature. If the cursor is positioned within the capture range of an object, and the Left mouse button is pressed, it will lock on to that object and display information about it in a pop-up window.

   Depending on which type of display is being viewed, the following information may be included:

> Altitude and Azimuth
> Right Ascension and Declination.
> Distance from Sun and Earth
> Phase of the object.
> Magnitude of the object.
> Constellation the object is part of.
> Meaning of Constellation name.
> > *i.e. Orion, "THE HUNTER"*
> Name of the object.
> Spectral Type of the object.
> Object Type
> > *i.e. Planet,Comet,Star,Double Star,Nebula*

Note: Object Identification is not available when the display is Auto Updating and the special cursor will not appear.

Zoom   In / Out

On certain graphical displays, the *Zoom   In / Out* feature is supported.   This feature is like changing the magnification of a telescope.   When you Zoom In, the objects move away from the center of the display, since the field of view gets narrower. Objects that are crowed together move apart and become more distinct.   When you Zoom Out, the objects move toward the center of the display, since the field of view gets wider.   More objects will fit on the display as you Zoom Out but they will also crowd together.

Daylight Savings Time (DST)

Your system clock should always be set to the correct   Local Time.   This includes daylight savings time if applicable.   If daylight savings time is not instituted where you are located or you do not want to set your system's clock in daylight saving time, Select **No Correction** on the pull down menu.   This will instruct the program not to make any corrections for daylight savings time and will expect the clock to be set to Local Standard time.

Three other Daylight Savings Time methods are supported: Select the one that is appropriate.

US Daylight Savings Time is assumed to begin on the FIRST Sunday in April and end on the LAST Sunday in October.
European DST   is assumed to begin on the LAST Sunday in March and end on the LAST Sunday in September.
Australian DST   is assumed to begin on the last Sunday in October and end on the First Sunday in March.

NOTE: To save changes to this selection, the Save Setup feature must be used.

Units of Measure

The **Units of Measur**e <u>pull down menu</u> allows you to select whether you wish measurements to be displayed in Miles or Kilometers (When the measurement units are other than <u>AUs</u>)

NOTE: To save changes to this selection, the <u>Save Setup</u> feature must be used.

Comet File Format

This file contains the orbital elements for periodic and parabolic comets. As a user, you are allowed to add more comets to this file. The file has the format:

field 1: Comet Type (p-periodic , n-non periodic, *-comment line)

**** for Periodic Comets ****

field 2: Perihelion Epoch
field 3: Perihelion longitude (degrees)
field 4: Longitude of ascending node (degrees)
field 5: Period (years)
field 6: Semi-major axis of orbit (AU)
field 7: Eccentricity (only values < 0.98)
field 8: Inclination of orbit (degrees)
field 9: Name of comet (no spaces, less than 20 chars)

***** for Non-Period (Parabolic) Comets ****

field 2: Perihelion Epoch date
field 3: Perihelion Distance (AU)
field 4: Argument of Perihelion (degrees)
field 5: Longitude of ascending node (degrees)
field 6: Inclination (degrees)
field 7: Name of comet (no spaces, less than 20 chars)

Any line with an asterisk (*) in the first column is treated as a comment line.

NOTE: *ALL* fields must be filled in for the particular comet type. Currently, minimal verification is performed on the data.

Right Ascension is the angle, measured in the equatorial system, from the <u>first point of Aries</u> in the plane of the Equator.

First Point of Aries is the position on the celestial sphere at the vernal equinox.

Declination is the angle, measured in the equatorial system, perpendicular to the Equator
North is *positive* and *South* is negative.

Local Time is the time with reference to your location on Earth based on your <u>Time Zone</u> and includes Daylight Savings Time when in effect.

Astronomical Unit (AU) is the length of the semi-major axis of the Earth's orbit about the Sun. It is equal to approximately 149.6 Million Kilometers or 92.96 Million Miles

Altitude is the angle up from the horizon.   Negative altitude means that the object is below the horizon.   90 degrees means that the object is directly over head.

Azimuth is the angle from the north point measured on the horizon.   North is 0, East is 90, South is 180 and West is 270 degrees.   This is the same measurement as made by a common compass.

Phase is the degree measure of how much of an object appears illuminated by the Sun as viewed from Earth.   0.0 means that the object is reflecting no light back to Earth, i.e. a New Moon. 180 means that the full disk of the object is reflecting light, i.e. a Full Moon.

Greenwich Mean Time (GMT) is the basis for the measurement of time on Earth. Local Time is derived from GMT and your Time Zone   A time zone of +6 means that your location is 6 hours behind the time at Greenwich, England.

A **Time Zone** is one of the 24 regions of the Earth, approximately coinciding with the meridians, at successive hours from the observatory at Greenwich England.

Magnitude is the unit defined on a logarithmic scale which measures brightness.   The more negative the value brighter the object.   i.e. an object who's magnitude is 1 is 10 times brighter as an object of magnitude 2.

Longitude is the angle measured around the Earth from the Prime Meridian.   In Hubble, West of the Prime Meridian are positive values and East are negative values.

Latitude is the angle measured up and down from the Equator.   North of the Equator are positive values, South are negative values.

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___ Hubble Disk(s)   @ $19.50 ea. $ _____

   (Texas residents   add 8.25% sales tax)   Tax $ _____

   Shipping   &   Handling $ 5.00____

                                                        Total $ _____

*** IMPORTANT *** ALL PAYMENT MUST BE THROUGH A US BANK IN US DOLLARS.

Payment by:
( ) Check drawn on US Bank in US Dollars
( ) International Money Order in US Dollars
( ) Traveler's Checks in US Dollars
( ) US Currency (for NON-US orders)

Sorry, no Credit Card or C.O.D. orders will be accepted.

Name: _____

Address: _____

         _____

         _____

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