NAME

predict − Track and predict passes of satellites in Earth orbit

SYNOPSIS

predict [-u *tle_update_source* -t *tlefile* -q *qthfile*]

DESCRIPTION

PREDICT is a multi-user satellite tracking and orbital prediction program written under the Linux operating system by John A. Magliacane, KD2BD. **PREDICT** tracks and predicts passes of satellites based on the geographical location of the ground station, the current date and time as provided by the computer system's clock, and Keplerian orbital data for the satellites of interest to the ground station.

The operation of **PREDICT** is uncomplicated by design. The start-up screen of the program lists the program's main functions. Several tracking and orbital prediction modes are available, as well as several utilities to manage the program's orbital database.

Orbital predictions are useful for determining in advance when a satellite is expected to come within range of a ground station. They can also be used to look back to previous passes to help to confirm or identify past observations.

PREDICT includes two orbital prediction modes to predict any pass above a ground station (main menu option **[P]**), or list only those passes that might be visible to a ground station through optical means (main menu option **[V]**). In either mode, the user is asked to select a satellite of interest from a menu, and then asked to enter the date and time (in UTC) at which prediction calculations should start.

The current date and time may be selected by default by entering nothing and hitting simply the ENTER key when prompted to enter the starting date and time.

Otherwise, the starting date and time should be entered in the form:

DDMonYY HH:MM:SS

After this is entered, orbital calculations are started and prediction information is displayed on the screen.

Pressing the ENTER key, the **Y** key, or the space bar advances the orbital predictions to a screen listing the next available passes. Pressing the **L** key allows the currently displayed screen plus any subsequent screens to be logged to a text file in your current working directory. The name given to this file is the name of the satellite plus a *.txt* extension. Any slashes or spaces appearing in the satellite name are replaced by the underscore (_) symbol. The logging feature may be toggled on and off at any time by pressing the **L** key. Exiting the orbital prediction mode by pressing **N** or hitting the **ESC**ape key will also close the log file. The log file will be appended with additional information if additional predictions are conducted for the same satellite with the logging feature turned on.

Selecting **[V]** from **PREDICT's** main menu will permit a ground station to only predict passes for satellites that are potentially visible through optical means. Since all other passes are filtered out in this mode, and since some satellites may never arrive over a ground station when optical viewing conditions are possible, the program provides the option of breaking out of visual orbital prediction mode by pressing the **ESC**ape key as calculations are made. A prompt is displayed at the bottom of the screen to alert the user of this option.

In either orbital prediction mode, predictions will not be attempted for satellites that can never rise above the ground station's horizon, or for satellites in geostationary orbits. If a satellite is in range at the starting date and time specified, **PREDICT** will adjust the starting date back in time until the point of AOS so that the prediction screen displays the first pass in its entirety from start to finish.

In addition to predicting satellite passes, **PREDICT** allows satellites to be tracked singly in real-time using

PREDICT's Single Satellite Tracking Mode (main menu option **[T]**), or simultaneously as a group of 24 using the program's Multi-Satellite Tracking Mode (main menu option **[M]**). The positions of the Sun and Moon are also displayed when tracking satellites in real-time.

Selecting option **[T]** from **PREDICT's** main menu places the program in Single Satellite Tracking Mode. The user will be prompted to select the satellite of interest, after which a screen will appear and display tracking positions for the satellite selected.

If a soundcard is present on your machine and the Single Satellite Tracking Mode is invoked with an uppercase **T** rather than a lowercase **t**, **PREDICT** will make periodic voice announcements stating the satellite's tracking coordinates in real-time. Announcements such as:

"This is PREDICT. Satellite is at 5 6 degrees azimuth and 4 5 degrees elevation, and approaching."

are made at intervals that are a function of how quickly the satellite is moving across the sky. Announcements can occur as frequently as every 50 seconds for satellites in low earth orbits such as the International Space Station (370 km), or as infrequently as every 8 minutes for satellites in very high orbits, such as the GE-2 geostationary satellite (35780 km). Voice announcements are performed as background processes so as not to interfere with tracking calculations as the announcements are made. Announcements can be forced at any time by pressing the **T** key in Single Satellite Tracking Mode (provided it was started with an uppercase **T**).

Selecting **[M]** from **PREDICT's** main menu places the program in a real-time multi-satellite tracking mode. In this mode, all 24 satellites in the program's database are tracked simultaneously along with the positions of the Sun and Moon. Tracking data for the satellites is displayed in two columns of 12 satellites each. A letter displayed to the right of the slant range indicates the satellite's sunlight and eclipse conditions. If the satellite is experiencing an eclipse period, an **N** is displayed. If the satellite is in sunlight and the ground station is under the cover of darkness, a **V** is displayed to indicate the possibility that the satellite is visible under the current conditions. If the satellite is in sunlight while conditions at the ground station do not allow the satellite to be seen, a **D** is displayed. Satellites in range of the ground station are displayed in **BOLD** lettering. The AOS dates and times for the next three satellites predicted to come into range are displayed on the bottom of the screen between the tracking coordinates of the Sun and Moon. Predictions are not made for satellites in geostationary orbits or for satellites so low in inclination and/or altitude that they can never rise above the horizon of the ground station.

PREDICT may be run under the X-Window System by invoking it through the **xpredict** script contained with the software. **xpredict** requires that *rxvt* be installed on your system, although the script can be modified to use *xterm*. Holding down the SHIFT key while pressing the plus (+) and minus (-) keys allow **PREDICT's** window to be re-sized.

OPTIONS

By default, **PREDICT** reads ground station location and orbital data information from a pair of files located in the user's home directory under a hidden subdirectory named *.predict*. Ground station location information is held in a file named *predict.qth*, while orbital data information for 24 satellites is held in a file named *predict.tle*.

If we wish to run **PREDICT** using data from alternate sources instead of these default files, the names of such files may be passed to **PREDICT** on the command line when the program is started. For example, if we wish to read the TLE file *visual.tle* and the QTH file *holiday.qth* rather than the default files, we could start **PREDICT** and pass the names of these alternate files to the program in the following manner:

predict -t visual.tle -q holiday.qth

or

predict -q holiday.qth -t visual.tle

If the files specified are not located in the current working directory, then their relative or absolute paths should also be specified along with their names.

It is also possible to specify only one alternate file while using the default for the other. For example,

predict -t visual.tle

reads QTH information from the default *~/.predict/predict.qth* location, and TLE information from *visual.tle*, while

predict -q bobs.qth

reads ground station location information from *bobs.qth* and TLE information from the default *~/.predict/predict.tle* location.

It is also possible to update **PREDICT's** satellite orbital database using another command line option that updates the database from a NASA two-line element data set. **PREDICT** then quietly exits without displaying anything to the screen, thereby eliminating the need for entering the program and selecting the appropriate menu options. This option is invoked using the *-u* command line switch as follows:

predict -u orbs248.tle

This example updates **PREDICT's** default orbital database with the Keplerian elements found in the file *orbs248.tle*. If an alternate datafile requires updating, it may also be specified on the command line using the *-t* switch as follows:

predict -t oscar.tle -u amateur.txt

This example updates the *oscar.tle* orbital database with the two-line element data contained in *amateur.txt*.

These options permit the automatic update of **PREDICT's** orbital data files using Keplerian orbital data obtained through automatic means such as FTP or pacsat satellite download.

For example, the following script can be used to update **PREDICT's** orbital database via the Internet:

```
#!/bin/sh
ftp -n ftp.celestrak.com << !
user anonymous $LOGNAME@$HOSTNAME
binary
cd /pub/elements
get amateur.txt
quit
!
predict -u amateur.txt
```

To truly automate the process of updating your orbital database, save the above commands to a file in your home directory (such as *kepupdate*), and add the following line to your crontab (type crontab -e to edit your crontab):

*0 2 * * * kepupdate*

and **PREDICT** will automatically update its database every day at 2:00 AM.

It is also possible to run **PREDICT** as a background process and direct its display to an unused virtual console by using the following command:

predict < /dev/tty8 > /dev/tty8 &

Switching to virtual console number 8 (ALT-F8) will allow **PREDICT** to be controlled and displayed even after you've logged out.

FILES

`~/.predict/predict.tle`
Default database of orbital data

`~/.predict/predict.qth`
Default ground station location information

AUTHOR

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