Gpredict satellite tracking software

Out of the Blue

yewkeo, 123RF

Predict and track satellite orbits and control amateur radio equipment with Gpredict satellite tracking software. *By Michael Gottwald*

Ever since the first artificial satellite, Sputnik, was launched by the USSR back in 1957, a large number of spacecraft of various designs have orbited the globe: from simple communications satellites, to observation probes with complex instrumentation, to the International Space Station (ISS).

Most of these artificial heavenly bodies are in low earth orbit (LEO) at altitudes between 200 and 1,200 kilometers. In contrast, TV and weather satellites use geostationary earth orbits (GEOs) of about 36,000 kilometers above the equator (the angular velocity is equivalent to one orbit per day, so a satellite at this location will remain above the same position on the surface of the earth). On a clear night, you can see many of these satellites as dots of light crossing the sky – nonexpert observers will tend to confuse them with aircraft.

One of the most popular ways to identify satellites and predict their orbits is with the Heavens Above [1] site, developed by Chris Peat. Heavens Above has offered predictions for many years by tracing satellite orbits on star charts. Additionally, more and more planetarium programs support satellite tracking and draw the paths of artificial satellites on their start charts.

Gpredict [2], which stands for Gnome Predict, focuses exclusively on satellites and thus offers far more options than Heavens Above.

AUTHOR

Michael Gottwald has been testing astronomy software for around 20 years, originally for Amiga magazines, and now mainly for "Sterne und Weltraum." The former Amiga geek is now a Linux enthusiast. He regularly follows astronomy and space activities on the web.

Installation Variants

Many distributions include Gpredict in their repositories, as is the case with Ubuntu, which I use on my lab machine. Although the *Universe* branch of Ubuntu 9.04 only offers an older Gpredict 0.90 package, Ubuntu 10.04+ comes with the

QTH LOCATOR

Also known as a QRA Maidenhead Locator [5], the QTH locator defines a grid square of the WGS 84 geodetic datum. Developed by amateurs at the end of the 1950s, and codified multiple times, this program helps facilitate calculating the distance and direction between radio network users. The QTH locator for Chicago, for example, is EN61EU.

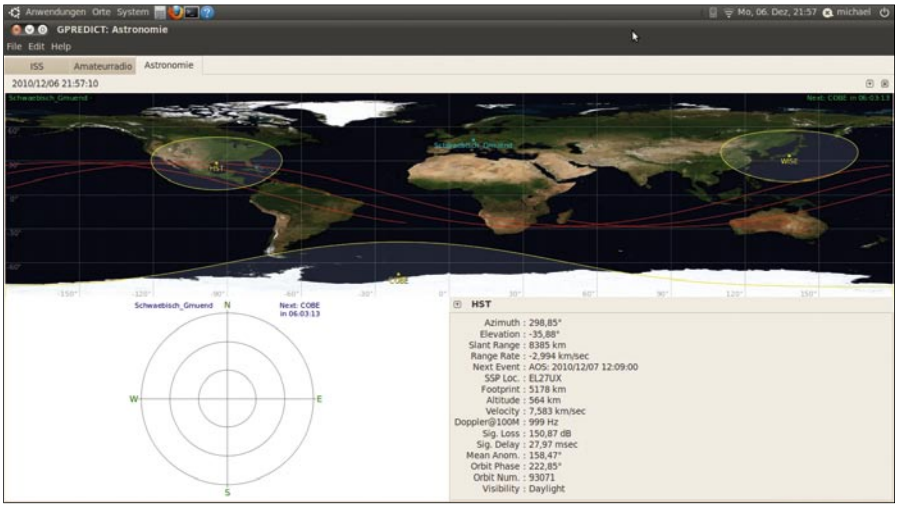


Figure 1: The main Gpredict window with a map of the globe (distorted because of the maximized window), information on the Hubble space telescope and the polar view.

earth, their orbit is affected by the friction of the residual atmosphere over time. The effect is fairly slight, but it can have a major effect on prediction accuracy. To update the data quickly and easily via the Internet, select *Edit | Update TLE | From network*. The update downloads the current two-line elements (a common format for representing satellite orbits as a block of numbers in two lines) for the satellites you have selected to observe.

Modular

Gpredict uses a modular design wherein each module contains an arbitrary number of satellites and a ground station. The program organizes the modules in tabs, between which the user can toggle. This design makes it possible, for example, to organize the satellites that you want to monitor by topic (astronomy, observation, weather, etc.) (Figure 1) or as lists (towns, resorts, etc.) for different ground stations.

When you create a new module (*File | New module*), you first need to assign a name, then select the ground station, and finally assign one or more satellites (Figure 2), either by selecting from the alphabetically organized list or by searching for a satellite by typing its name. The search algorithm is slightly

more recent 1.1 version. However, the latest version of Gpredict is 1.2. To install this version, download the source code [3] from the Gpredict website then be prepared to tackle a number of obstacles. Ubuntu 9.04 can't resolve some version 1.2 dependencies because more recent versions of Gtk+ and GLib are not available as packages for 9.04.

Despite the error message that intltool is too old, I was able to build Gpredict 1.2 on Ubuntu 10.04. However, I was unable to download the required libfreetype6 packages, although the package manager listed them. Instead, I turned to the Ubuntu package search site [4]. Before compiling the source code, you might also have to install the developer packages for the required libraries that relate to Gtk+ 2.12, GLib 2.16, libcurl 7.16.0, GooCanvas 0.9, libfreetype6, Hamlib (run time only), and others, depending your distribution.

Control Center

After starting Gpredict, you might be reminded of a space mission control center with screens that plot the orbits of space stations as lines on a map of the earth (Figure 1). The basic configuration splits the main window into three sections: the map of the globe I just referred to, the satellite info areas, and the polar view. The map of the globe also displays all the selected satellites including their footprints, which is the area on the surface of the earth from which you can see the satellite.

The first step is to define your location, which Gpredict then uses as its ground station. Typically, you can choose from a long list of locations, which Gpredict offers below *Edit | Preferences* in the *Ground Stations* tab of the *General* menu. For ease of use, the program sorts the list by regions such as Europe, Asia, United States, and so on.

If none of the cities Gpredict offers is near your home, you can define the location manually. To do so, you need to enter the name of your location and its geographic coordinates; all of the other details are optional. Entering the *Altitude* predicts the atmospheric refraction when calculating the orbit. The program calculates the *Locator* itself (see the "QTH Locator" box).

The *Preferences* window is also where you define the numeric format to use, the module views, the content of the prediction lists, the time resolution, and many other things. If needed, you can also configure your radio equipment and antenna drives here. By choosing to *Show local time instead of UTC* in *Number Formats*, you will be able to make more sense of reported times.

If Gpredict doesn't tell you to do so, you should update the orbit elements of the satellites directly after installation and then a couple of days later. When satellites orbit the

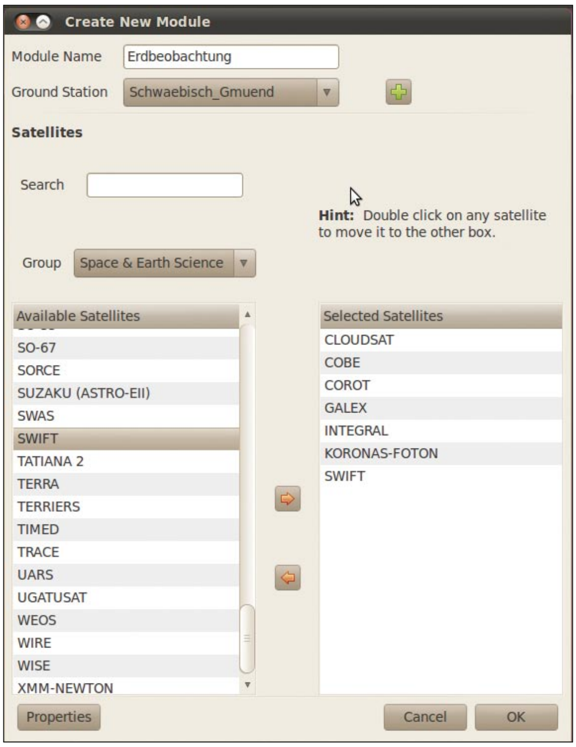
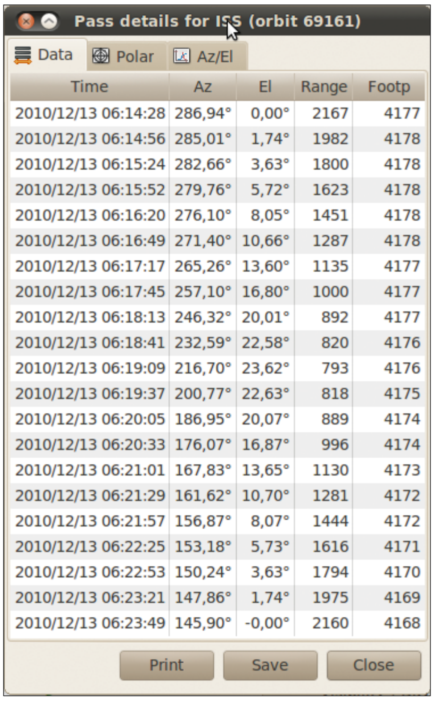


Figure 2: Users can select from 1,200 satellites and group them as needed.



Pass details for ISS (orbit 69161)

Data | Polar | Az/El

Time	Az	El	Range	Footp
2010/12/13 06:14:28	286,94°	0,00°	2167	4177
2010/12/13 06:14:56	285,01°	1,74°	1982	4178
2010/12/13 06:15:24	282,66°	3,63°	1800	4178
2010/12/13 06:15:52	279,76°	5,72°	1623	4178
2010/12/13 06:16:20	276,10°	8,05°	1451	4178
2010/12/13 06:16:49	271,40°	10,66°	1287	4178
2010/12/13 06:17:17	265,26°	13,60°	1135	4177
2010/12/13 06:17:45	257,10°	16,80°	1000	4177
2010/12/13 06:18:13	246,32°	20,01°	892	4177
2010/12/13 06:18:41	232,59°	22,58°	820	4176
2010/12/13 06:19:09	216,70°	23,62°	793	4176
2010/12/13 06:19:37	200,77°	22,63°	818	4175
2010/12/13 06:20:05	186,95°	20,07°	889	4174
2010/12/13 06:20:33	176,07°	16,87°	996	4174
2010/12/13 06:21:01	167,83°	13,65°	1130	4173
2010/12/13 06:21:29	161,62°	10,70°	1281	4172
2010/12/13 06:21:57	156,87°	8,07°	1444	4172
2010/12/13 06:22:25	153,18°	5,73°	1616	4171
2010/12/13 06:22:53	150,24°	3,63°	1794	4170
2010/12/13 06:23:21	147,86°	1,74°	1975	4169
2010/12/13 06:23:49	145,90°	-0,00°	2160	4168

Print | Save | Close

Figure 3: Passage details for the ISS (International Space Station) on the morning of December 13, 2010.

quirky: Gpredict doesn't search for a name that starts with the string you type but outputs the first name that contains the string at any position. This means that as you type *IRA* (to find the IRAS infrared satellite), you first get *ARIRANG 1*, until, after typing the full name, you get IRAS. Additionally, the search function is case sensitive, which doesn't really matter because the satellite names in the list are all in upper case.

The ability to display the selection list for a specific group is a useful search feature: for example, you can choose to display *Space & Earth Science*, *Geostationary* or a more specialized group like *Latest Launches*.

Each new module you create is organized in a tab of its own. The satellites assigned to the group are displayed on the map of the globe with their footprints. If you mouse over a satellite, you see a bubble (at least in versions post-Gpredict 0.9) with details of the current coordinates and the time in minutes until the next acquisition of signal (AOS) at the ground station. If the satellite is currently visible above your ground station, you are shown the number of minutes until the loss of signal (LOS). To see the satellite track, right-click and select the *Ground Track* function in the drop-down box.

Ground Track

The *Future passes* menu item takes you to a table of passes to occur within three

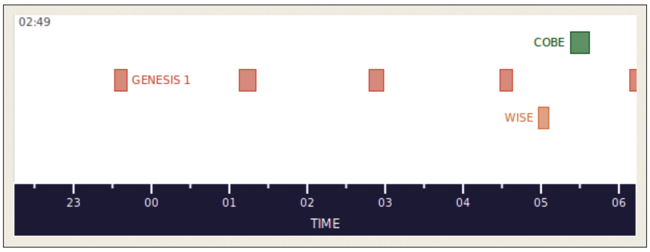


Figure 5: The visibility diagram for satellites in the selected module.

days. The right-hand column, *Vis* (visibility), indicates whether the pass will be visible (*V*) or hidden (*E*, eclipsed). To get the best view of a satellite, note that it will be in sunlight while your location is in the night, or at least twilight, zone.

To enable this column, you can check the *Visibility during pass* box in the *Multiple Passes* tab of the *Predict* pane in *Edit | Preferences*. This setting puts Gpredict in a different league from, for example, Heavens Above, which only lists visible passes, and it also explains why the details of satellite passes can differ between two sources of information.

Double-clicking a line in the satellite list gives you a detailed overview of the pass (Figure 3). The *Data* tab is a table of individual orbital positions, including the date and time and the coordinates in azimuth (*Az*; the angle between north and the perpendicular projection of the satellite to the horizon) and elevation (*El*) formats.

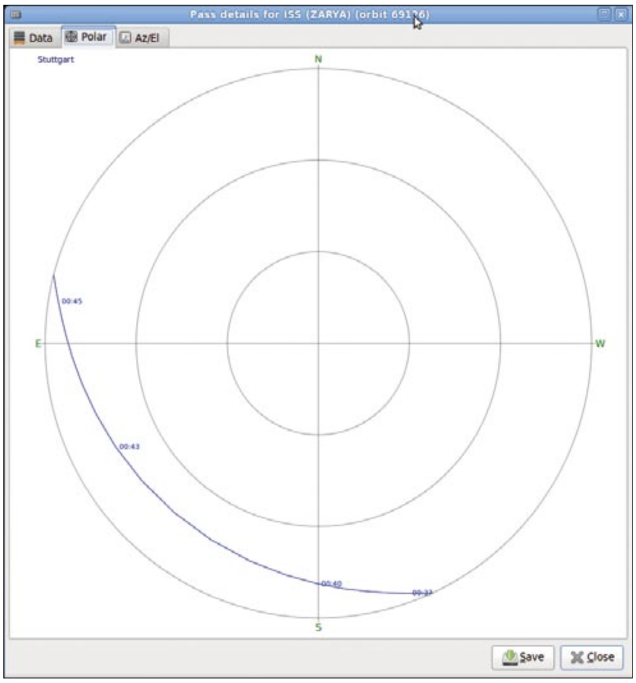


Figure 4: The polar view shows the passage of the International Space Station through the sky above Stuttgart, Germany, in the early morning of December 13, 2010.

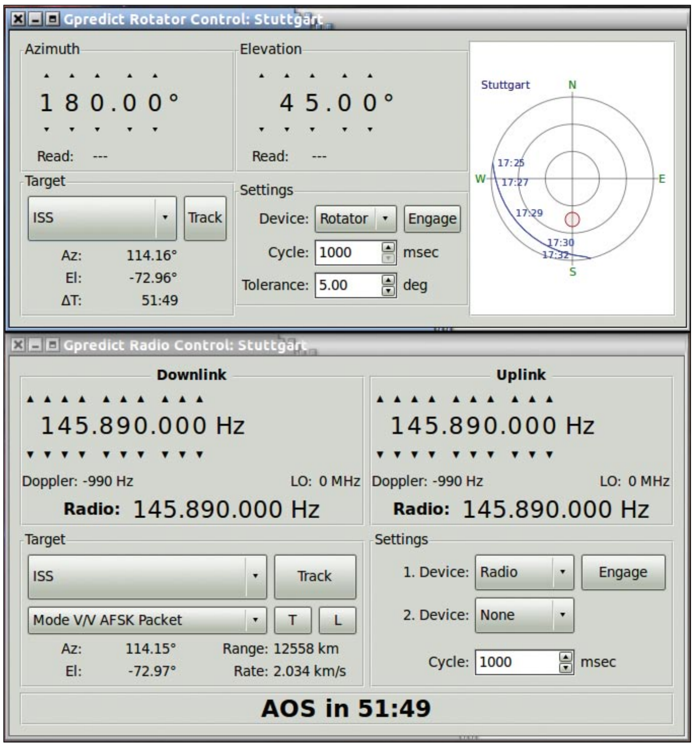


Figure 6: The Gpredict antenna and radio controls.

The number of degrees in the *El* column shows how high above the local horizon the satellite will be at a given time (largest positive value). Depending on the maximum elevation and the height of the orbit, the satellite will cross the sky more quickly or slowly. This table can also be printed or saved.

Visualization

For visualization, the second tab contains a polar diagram (Figure 4, which is also shown on the bottom left in the main window by default) that shows the local sky without the stars and constellations but with cardinal points.

To modify the orientation of the map, depending on your direction of observation, choose one of the *Orientation* radio buttons in the *Polar View* tab of the *Modules* pane in *Preferences*. The third tab, *Az/El*, contains a visibility chart that lets you see whether the selected satellite is visible.

A small arrow on the right-hand side of each module pops up a menu with 10 entries. One really interesting menu item here is *Sky at a glance*, which pulls up a visibility chart of the satellites assigned to the module along a time axis (Figure 5). Here, you can see which satellite will appear when and how often within the configured period of time (default: 8 hours).

Gpredict is not just limited to the current day or to prediction tables; it can also give you an accelerated time display, or run time backward with *Time Controller* from the pop-up menu.

Remote Control

Finally, don't forget a really important feature in Gpredict: its radio and antenna control function, which relies on the Hamlib library. The Ham radio equipment libraries let you write programs to control amateur radio equipment from your PC and actuate special antenna rotors so Gpredict can track a selected satellite (Figure 6). Because of a lack of hardware, I was unable to test this feature. The comprehensive Hamlib manual in the Gpredict manual [6] provides more details.

Gpredict is well-written satellite tracking and orbit prediction software that also allows control of amateur radio equipment. The interface is intuitive and offers everything you would look for in a tool of this kind.

The well-structured 64-page PDF manual and tooltips will help users find their way around the program. ■■■

INFO

[1] Heavens Above: *http://www.heavens-above.com/*

[2] Gpredict website: *http://gpredict.oz9aec.net/*

[3] Gpredict download: *http://sourceforge.net/projects/gpredict/files/*

[4] Ubuntu package search: *http://packages.ubuntu.com*

[5] QTH locator: *http://en.wikipedia.org/wiki/Maidenhead_Locator_System*

[6] Gpredict manual: *http://voxel.dl.sourceforge.net/project/gpredict/Gpredict/1.2/gpredict-user-manual-1.2.pdf*