Stellarium version 0.18.0

Georg Zotti

Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna
Georg.Zotti@univie.ac.at

Alexander Wolf

Altai State Pedagogical University, Barnaul (Russia)
aw@altspu.ru

In our second instalment after our introductory overview of Stellarium (Zotti and Wolf 2017), we want to highlight the latest developments, and go a bit into detail about the landscape panoramas which you can use to decorate your horizon.

For version 0.16 we were able to raise temporal accuracy of Solar eclipses to fall within a few seconds of dedicated “official” predictions, just in time for the American eclipse of 21st August, 2017. The change is a temporary solution only, related to Stellarium’s current slight deficit of not dealing with annual aberration, which also explains why the season begin times (when the Sun’s geocentric ecliptic longitude is a multiple of 90°) deviate by a few minutes from the data given in the Nautical Almanac and other “official” sources. We see aberration as one of the few critical missing features blocking the long-expected release of version 1.0.

The new feature most welcome to cultural astronomers in v0.16.1, released during last year’s SEAC/INSAP/Oxford conference on 22nd September, may be the asterisms, which are similar, but also additional “unofficial” named line sets like the existing constellation “stick figures”. At the conference, Georg Zotti also presented a way to put temporal changes into the 3D sceneries which you can explore or demonstrate in Stellarium (Zotti *et al.*, in press). The Scenery3D plugin meanwhile has been used with models of over 14 million triangles on a mid-range notebook PC, and has also been shown to deliver accurate shadow simulation.

The European Space Agency has again sponsored a student for us in its “Summer of Code in Space” programme of 2017. Teresa Huertas Roldán implemented a way to show planetary feature nomenclature, for example craters on the Moon or Mars. This is one of the highlights of version 0.17, which appeared at winter solstice 2017. Most other improvements of that version are geared towards observers, like INDI telescope support.

While we are writing these lines, we are also just preparing version v0.18 to be released around spring equinox 2018. In addition to the DSS layer of photographic sky coverage, Guillaume Chéreau has added a HiPS client (Fernique *et al.* 2015) to visualise a whole set of such coverages in various spectral areas – over 200 sets are available at the moment and the number is increasing day-by-day as part of the Virtual Observatory services. Technically this new feature can also be used for texturing solar system bodies, and paired with the nomenclature feature it can become very interesting and helpful for observers. If you are also a modern astronomer, you will surely like it! And the AstroCalc panel also has new features: Monthly Elevation and Planetary Calculations. The former can display the altitude development of a planet during a whole year for a given local time, while the latter feature can quickly calculate parameters between two selected solar system bodies, for example angular distance, synodic period and so on. Additionally, the AstroCalc panel has received some important improvements in other parts, such as “Altitude vs. Time” which may show daily development of solar (including lines for civil, nautical and astronomical twilight) and lunar elevation in addition to the elevation of a selected celestial body. You will also find more time-step options for the “Ephemeris” tool.

The Stellarium project itself has undergone a few technical changes. We moved our code repository from Launchpad to Github (Stellarium 2018) and are now using a better-known software tool for collaborative development. Project founder Fabien Chéreau was right in his assumption, as this step has immediately brought a few contributions from other developers (like the abovementioned INDI support), and we are of course hoping for more: Stellarium, as community project, lives mostly on voluntary contributions, and the fastest way to get a new feature into Stellarium is to do it oneself. We also accept suggestions, but they may take longer to be implemented.

Landscape Notes

Occasionally we receive a question about why the horizon panorama (“landscape” in Stellarium’s terms) does not move down when you increase observer location altitude. Sorry, but how should that work, technically? On a spherical Earth without mountains, we could indeed move our sea level “Ocean” landscape down in response to the eye point lifting off the ground. But the photographic landscape panorama you want to see changing has been made at a particular site and is linked to the mathematical horizon (and the horizontal grid in general) at that site! If we were to go up in a balloon or helicopter, distant parts of the landscape would have to move downwards more slowly than nearby parts. But we have a photograph only, without distance information! If you need such an effect, you must build a 3D scenery, but be aware that this currently also only presents the landscape on a tangential plane; that is, a flat-earth approximation. Very distant mountains therefore would appear a bit too high.

Let us present one special case, though. If you prepare a 3D scenery and need to model, as background horizon, a flat sea seen from a steep cliff of, say, 85 m elevation, you can copy the “Ocean” landscape from the program folder into a new landscape subdirectory (with different name!) in your personal Stellarium folder (you should

not try to copy anything into the write-protected program folder!), do the necessary computations of horizon dip and rewrite a few entries in the landscape.ini file. The “Ocean” landscape is a kind of multitexture landscape called “old_style”, because it was the original kind of landscape from the earliest period of the program when such panorama photos were made available as horizon decoration. Meanwhile, the much simpler “spherical” kind has been introduced, but this only uses one texture image and may not deliver the high quality possible with the multi-image approach.

Apart from a changed “name” entry, and likely the addition of your location coordinates (with altitude = 85), the relevant entries in this configuration file to adjust the photographs are

```
decor_alt_angle = 45
decor_angle_shift = -45
calibrated = true
```

These mean that the vertical extent of the series of images which make up the images along the horizon is 45°, and that this vertical extent is shifted down by (coincidentally) also 45°. This means the upper edge of the image should lie along the mathematical horizon. (this can be verified by activating the “Ocean” landscape and the horizontal coordinate grid in Stellarium and observing that the photographic horizon is exactly at altitude zero on the grid.) Unfortunately, in early versions of Stellarium the formula to place the horizon into the spherical grid had a slight error, and the images of several horizon sets were only placed visually along the horizon for decoration. Years ago (v0.10.6) we introduced a repair, but had to add a configuration keyword to the landscape.ini file to mark accurately placed photos as “calibrated” (so that the new placement algorithm is applied), or else all previously created landscapes would have been “off”.

Now we have to do something about the sealine horizon dip from $h = 85$ m elevation. An approximate formula (for example from Wikibook 2018) for horizon distance on a spherical Earth of radius r is $d = \sqrt{2hr}$. With $r = 6371$ km we get $d = 32,910$ m. The dip angle θ is equal to the angle at Earth’s centre between observer and horizon, $\tan(\theta) = d/r$ from which $\theta \approx 0.0052$ rad = $0.296^\circ = 17'45''$. We have to shift our horizon line down by this amount. Our value for decor_alt_angle therefore has to be reduced to $45 - 0.296 = 44.704$. The entry for decor_angle_shift will stay the same. Note that this rough estimate does not take terrestrial refraction into account, which will raise the horizon again a bit, but you should get the point here. We can only move the landscape horizon line when we know its distance.

Most of us are probably annoyed meanwhile by our computer systems permanently auto-updating behind our backs. Stellarium never auto-updates itself, just some data files. If you want to use the latest features mentioned above, you yourself must still install the latest official version or even the weekly beta from <http://stellarium.org>. Stay tuned!

References

Fernique, P. *et al.*, 2015. “Hierarchical Progressive Surveys: Multi-Resolution HEALPix Data Structures for Astronomical Images, Catalogues, and 3-Dimensional Data Cubes”. *Astronomy & Astrophysics* 578: Art. A114.

- Stellarium, 2018. Github repository [online]. Accessed February 2018. <https://github.com/Stellarium/stellarium>
- Wikibook, 2018. "Trigonometry/The distance and dip of the horizon". [online] Accessed March 2017. https://en.wikibooks.org/wiki/Trigonometry/The_distance_and_dip_of_the_horizon
- Zotti G., F. Schaukowitsch and M. Wimmer, in press. "Beyond 3D Models: Simulation of Temporally Evolving Models in Stellarium". *Mediterranean Archaeology and Archaeometry* (Proc. SEAC2017).
- Zotti, G. and A. Wolf, 2017. "Stellarium V0.16.0". *Journal of Skyscape Archaeology*, 3 (1): 167-169. <https://doi.org/10.1558/jsa.33304>