No luck, I'm sorry to say. I got quite excited by the possibility that it might have been the decay of Feng Yun 1C debris piece J (1995 25J = #29720) which I suspect was the only re-entry on that day. SpaceTrack list this as decaying on the 2nd, even though they also list an orbital element set for it early on the 3rd. My own calculations suggest that it decayed at about 11h UT on the 3rd. However, if I force it to stay in orbit for another few revs, then it would pass over South Africa, and over the area of the reports, at about 16h25 UT (18h25 SAST)! Sadly, though, it would have been moving from south to north – the opposite direction to what was seen. So it could not have been this object. Despite the long duration of the sightings, I suspect that this was meteoric.

Based on the observed paths I determined if the object had impacted that the fall site would be somewhere in the Eastern Cape or offshore in the Indian Ocean.

Clare Flanagan commented further:

I asked the [editor of the] Daily Dispatch in East London if they'd had any reports, none that he knows of, but he'll ask around in the newsroom and let us know.

No further reports of the object apart from the original sightings were received.

Conclusions

Based on the observations in Table 1, and the comments of Alan Pickup, I conclude the object was a bright bolide occurring at 18h27 SAST on the evening of 3 May 2007. The reports do not permit a determination of any fall site with sufficient accuracy, neither were any meteorite falls reported. The wide range of observing sites probably indicates the object grazed the upper atmosphere at low geocentric velocity before passing well south of the country. ☆

How To … Visually Observe Satellites

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Introduction

Most sky watchers no doubt have seen an artificial satellite slowly cross the sky or flash across their field of view. Visually they look like slowly moving stars that may appear steady or flashing or go through a longer cycle of being faint and bright. Sometimes they may suddenly appear out of nowhere as they come out the Earths shadow or fade away as they enter the shadow, usually associated with reddening of the satellite's colour.

Since October 1957 amateur astronomers have played a role in tracking satellites. Many of the members of the MOONWATCH network set up in the late 1950's were amateurs but the larger majority were ordinary people with little or no scientific training or knowledge who were fascinated by following moving points of light. Today MOONWATCH has long disappeared but some still pursue this occupation.

Visual satellite tracking

One loose definition I found that describes it well is: "Visual satellite observing is an interest in locating, viewing, analyzing and identifying these points of light that move across the sky" from an article that attempts to get more people to look upward and perhaps join the tracking community. It can range from simply observing a satellite to actually making measurements, etc that will contribute to the knowledge about a satellite. Like any hobby, the more effort you put into it, the more gratifying is the reward of having "done something".

Artificial satellites are like planets – they shine by reflecting sunlight and for them to be visible one needs to have a sky background that is reasonably dark, which means night observing. Some satellites may be seen in the day but this is a specialized field which will not be covered here. Another requirement is that they be clear of the Earth's shadow, since, like the Moon, they can experience eclipses. And the closer the satellite to Earth, the more often "eclipses" occur. As a general rule the best time to see a satellite is around 90 minutes after the end of evening twilight or before dawn twilight. Of course satellites can be seen outside this loose requirement but then they have to be orbiting higher than the majority of the easily observed objects. Obviously the closer a satellite is to an observer the brighter it will be and the faster it will cross the sky. Thus, visibility of a satellite can range from a few minutes up to hours.

Satellites go through phases like our Moon. This shows up as a varying brightness depending on the satellite position relative to the Sun and the observer. Our Moon is brightest when in the opposite direction of the sky to where the Sun sets (ie full Moon). A similar rule applies to satellites – your best chance of seeing a random satellite occurs when you stand with your back to where the Sun sets (or rises). It is not as simple as that because of the Earth's shadow which slowly rises in the east and moves towards the west as evening advances so its always best to try and look "ahead" of the shadow. As a rough guide, start looking at an elevation of about 30 degrees or more above the eastern horizon shortly after sunset as soon as the first stars appear. Slowly increase the elevation to perhaps overhead, 90 minutes after sunset. Of course you may also look further westward but the phase effect will diminish the brightness or magnitude somewhat. All the above is equally applicable before sunrise where everything must be reversed.

The brightest satellite is the International Space Station (ISS) and can be seen in daylight if you know exactly where to look. All the satellites (apart from geostationary objects) go through visibility cycles, so are not visible every night nor in the same directions or at the same times, so one needs predictions. These visibility cycles are quite complex as there are quite a few variables involved, but they can be calculated – so always make sure to get the latest predictions available – especially for such objects as the ISS which does frequent "orbit burns" to maintain its altitude.

The majority of satellites are in "polar" orbits that appear to be moving north to south or south to north. This is because highly inclined orbits to the Earths equator provide maximum coverage for communication, Earth observation, etc. A fair percentage have a strong westerly to easterly direction as this track is mainly used for launching satellites into geostationary orbits, leaving behind their space junk. In the first few decades of the space age it was also strongly favoured because it required less powerful rockets to achieve orbit, taking advantage of the Earth's spin. Seeing a satellite move from east to west is rather rare. There are a few in this type of orbit but they are mostly too faint to be seen by naked eye. This type of orbit is seldom used nowadays, perhaps only by Israel.

Getting started

But what do I need to see satellites? Obviously reasonable eyesight to start with, especially if you just plan to do one-power viewing (ie naked eye). At a rough guess there are perhaps as many as 200 satellites that can be seen naked eye. Using a pair of binoculars increases the number visible several times. The ideal binocular is 7x50 but the lighter 8x35 is also useful. Going to more powerful binoculars usually means some kind of mounting as 20x80 binoculars are rather too heavy and too high magnification to use handheld. Telescopes are not really practical as their field of view is too small for general viewing.

Although one stands a good chance of seeing satellites just by looking at random, it does help if you know when and where to look. You thus need predictions. These come in two main flavours – a simple text printout of the satellite's co-ordinates at specific time intervals or the satellite track superimposed on a star-map with time tick-marks along the track.

The best place to start, even before understanding co-ordinate systems, is http://www.heavens-above.com/ where you can get predictions for any geographical location on Earth. You observing position can either be selected from their huge database or by their nice new graphical Google Maps interface. Only bookmark it after you selected your site, saving you the trouble next time. Start with the brightest satellites like the International Space Station (ISS), Hubble Space Telescope (HST), etc. The site also provides predictions for Iridium satellite flares that can go as bright as magnitude -8 – a good way to impress your friends with your ability to see into the future where a UFO is going to appear! Heavens-above can also be used after the event to help identify an unknown satellite or flare that you saw. Although the brighter, more popular satellites are primarily covered on this site, you can also do predictions for more obscure satellites as you get to know their US Space Command ID, etc. The predictions given by heavens-above is a good introduction to both the co-ordinate as well as a the star-map type.

What next?

As you get more advanced, your list of requirements expands. You need to improve your pointing to find fainter satellites. If not using the stars as a reference (eg Right Ascension and Declination) then you must be able to accurately measure azimuth and elevation. Azimuth is the angle in the horizontal plane, increasing clockwise with 0˚ at true north – eg 90˚ is east, 270˚ is west, etc. Elevation is the angle between the horizon (0˚) and overhead (90˚). To help you aim your binocular/monocular, you can construct a simple system using protractors – for an example of such a system, see http://www.saao.ac.za/~wpk/satscope/satscope.html. Being tripod mounted, this will allow the use of higher power instruments, even enabling you to do video tracking by piggybacking a low light camera on the mount.

If you get bitten by the bug to pursue this hobby then you will need to do your own predicting. It's not difficult and software is freely available on the Internet (see this months *Software Corner,* p.211, for some useful programs). Do not forget; always download the latest orbital elements when you plan to predict/track. Satellites sometimes run like the trains – not always on time! It is also worthwhile joining a satellite tracking news group where you can compare and report observations. The SeeSat group is the best one at http://www.satobs.org/. Here you can ask for help and guidance and someone is bound to reply.

You would also need to improve your timing. Obviously one needs a stopwatch (or some means of accurately measuring time) to determine flash periods and for positional work one needs time accurate to at least 0.1 sec. This can be difficult. I personally use a GPS "engine" that provides me with accurate time. You also need to know your geographical position as accurately as possible – again using a GPS unit.

Astronomical telescopes are ideal for the higher/fainter satellites which you might want to view as the bug to observe bites you deeper. Being particularly lazy and not having the best eyesight, I have opted for the easiest way – observe the satellites using video techniques. I sit in a dark warm room in front of a computer monitor connected to a supersensitive video commercial surveillance camera and watch the satellites cross the field of view or track them automatically. Satellites as faint as magnitude +8 or +9 are possible at this other extreme end of the scale.

What else?

After having seen a few dozen satellites you might want to get more involved in the hobby of tracking satellites. What can one do? The easiest is to note the "optical characteristics" of a satellite – how bright is the satellite, how does it change its appearance as the phase angle (angle between Sun, observer and satellite) changes, is it steady, does it flash, does it vary and if so how many seconds between flashes etc. You might want to determine the position of the satellite at some known time that is useful for orbit determination. This is only necessary for satellites whose orbital data is not in the public domain (loosely referred to as "classified" satellites but includes satellites lost or not tracked by the official tracking agencies). This is a more specialised aspect of tracking and requires some skill but some of the so-called classified satellites are easy naked eye objects.

One might want to set up some challenges – how many satellites can you observe in an hour/month/year, what is the furthest distance satellite you can track, or observe new launches and be the first to see them. Try and track satellites nearing the end of their life as they decay in the Earth's atmosphere to eventually burn out like a meteor. You can also do your own orbit determination or get precise positions and see how good an orbit you can derive. Another interesting aspect is to look for occurrences when two satellites will pass close to one another – and possibly impact!

You could select a certain category of launch vehicle and compare them optically. If a satellite is flashing, follow the change in flash period as gravitational forces cause it to decrease in period – some actually spin up again suddenly due to unspent fuel/gas escaping, others experience seasonal effects due to changes in the Sun's radiation pressure. Locate and track objects known to manoeuvre, especially those in highly eccentric (egg-shaped) orbits. Seek and find uncatalogued objects. Although some 11 000 odd objects are catalogued and tracked, there is a fair percentage that are not. This is perhaps the most difficult challenge as it involves accurate positional work and observing skill. The ultimate challenge would be to try and observe every major object in orbit – this could take you years and has not yet been done by anyone!

A few amateurs actually try and image the bigger/brighter satellites so as to see the actual shape of the satellite. This is quite difficult (ie read expensive!) as you need a good GOTO telescope equipped with a suitable tracking program. It is quite difficult to keep a satellite in the field of view of about 10 arc minutes. The ISS satellite has an apparent size approximately equal to that of Jupiter, so if you see Jupiter as a nice oval disk, then you could capture the shape of ISS !

After reading this, get the "Visual Satellite Observing FAQ". This is an article of about 200 pages or so covering all aspects of visual satellite observing (as of Feb 1998 – video observing only appeared after that!) and can be downloaded from http://www.satobs.org/faq.html (also check out the rest of the site!) or http://home.att.net/~sue.worden/SeeSat-FAQ. A site closer to home is that of our Editor http://www.saao.ac.za/~wpk/map/sitemap.html and follow his satellite links. ☆