

Yarragadee SLR Station (MOBLAS-5) Scheduling and Optimal Tracking Strategies

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Abstract

With the recent increase in the number of GNSS satellites on the ILRS tracking roster a more sophisticated strategy may improve the value of the tracking results for all science customers without a change in station resources. Current motivation for observers and stations is number of NPs and passes with little regard for which satellite. Those motivations have, in the past, nearly always produced the “best” results but it is not now necessarily so. At Yarragadee, we more and more use the 3x3x3 NP minimum rule as the scheduling guide. What are the best strategies and metrics to motivate and recognize tracking that yields what is most needed by the science customers. It may not be raw NP and pass numbers? Could ILRS strategies vary, using one strategy for stations/situations with little or no overlap with others and using another strategy for stations/situations with much sky coverage overlap (Europe).

Scheduling Pressures

Now that GNSS constellations are filling, there are many more satellites on the ILRS tracking schedule. At Yarragadee we currently only have the single aperture and scheduling refinement has become a critical issue. We have traditionally noted and rewarded high normal point acquisition rates, which we have equated with high performance. Lately it has become more and more apparent that simply obtaining the most NPs does not necessarily mean that the best tracking strategy is being employed. This especially evident when tracking the more difficult GNSS targets such as the IRNSS or “low grade cpf” Compass satellites. It is quite often the case that potential NPs on easier targets will be sacrificed when trying to obtain sufficient returns on the harder satellites. This is sometimes a very difficult thing for the operator to accept.

Of course having “too many” targets raises the challenge level which is usually a good thing, but we need to keep in mind that it can increase stress levels for the operators.

Scheduling at Yarragadee

We use the ILRS and NERC priority lists as guides when scheduling and when tracking use horizon to horizon coverage as the ideal but try our best to get good coverage centred on PCA as the “rule”.

With this in mind, when selecting GNSS targets, we will opt for the satellites for which we can meet the 3x3x3 NP requirement. Of course sky conditions (including weather and solar angle), will mean this cannot always be met for all targets, but it acts as a selection guide when there are choices to be made.

We are also continually increasing the interleaving rate to best meet the above requirements. Where once not so long ago, we would track lageos and uninterrupted from horizon to horizon, that is now a luxury we can rarely afford and we have to interleave HEOs as well as LEOs in with the lageos passes. Fortunately few NPs need to be missed if the interleaving is done with NP boundaries in mind. It is now common for us to take around 170-180 pass segments in a day, whereas only a year ago we would only have taken around 100. This is due to the increased interleaving rates.

The MOBILAS5 system has a few improvements over the standard MOBILAS to enable higher tracking densities. The main improvements are:

The ability to combine and automatically process receive chain amplifier and non-amplifier passes in the one scenario. We use the amplifier for all HEO passes and the mixed scenario capability is a real bonus.

An auto-translator which means a full double set of calibrations only takes four minutes between scenarios.

The Yarragadee Gold Medal Reward System

To encourage and modify operator performance, we have something we call the gold medal awards each month. Whereas once the only “gold medals” on offer were for the highest total NP’s and highest average NP’s per shift for the month, now we have several categories.

These include (all on a per shift average basis):

Most NPs

Most Campaign Satellite NPs

Most Daylight HEO NPs

Most IRNSS NPs

Most Pass Segments

These are easy to automatically tally and award but are subject to some degree of gaming. So far we have not found a way to easily award individual medals for good pass coverage practices, but I am working on that.

Other Scheduling Tools

As well as the gold medals to guide the operator a number of simple aids have been set up to help the operator select the best target.



Fig 1 Satscape and sky condition monitors.

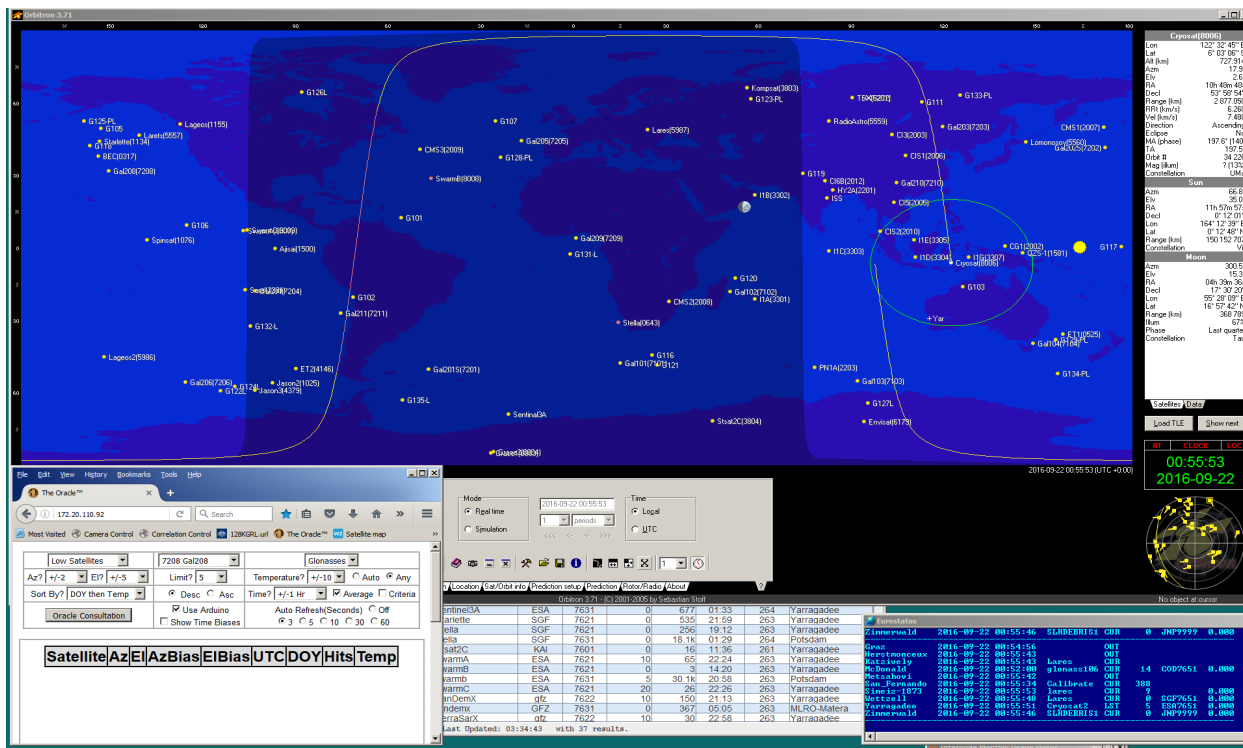


Fig 2 Orbitron and bias tools

When selecting which GNSS targets provide the greatest potential to meet the coverage requirement guidelines, it helps to see the satellite visibility as well as current and future sky conditions. The screens shown in Figs 1 and 2 are permanently available for the operator as an aid in real-time scheduling.

One of the aids we use is the real time status exchange (or eurostat). Up to now its use has been limited to a handful of stations and for us at least we only use it for bias monitoring amongst those stations. If most or all of the ILRS stations joined the service, could we use the data for real time scheduling improvements? For example should densely located sites such as in Europe select different targets from those successfully acquired by their neighbours? Or on the other hand is it ideal for down-track stations to obtain data on GNSS satellites ranged to by earlier stations at the expense of those missed earlier? It is not something we consider yet at Yarragadee – we just try and get a bit of everything possible – but that approach does get harder as the constellations fill.

Some Scheduling Questions

Is the GNSS coverage adequate for purpose? Would it be better to have a prime subset of Galileo targets as per Glonass?

This has been partially addressed since the workshop with a more elaborate prioritizing of the GNSS constellations by the ILRS. The new priorities are a great aid for the operators when scheduling.

Is it better to concentrate on one or two RNSS targets per day at each station and get better pass coverage or get a few NPs for each visible satellite per day?

Is the single segment GNSS pass at all useful?

Are there some LEOs that don't require every station to track every day? If not how to coordinate and of course everyone wants the NP gold medal!

How do we give credit for best coverage for each satellite?

Should we be occasionally be tracking the quiet non-listed Glonass?

Conclusions

The increased demand placed on the stations by the ever increasing GNSS/RNSS constellations needs to be better managed to both ensure the optimum results are obtained and operator stress levels are contained.

It is no longer adequate to simply obtain the maximum number of Normal Points per shift/day/month/year and assume the best results are being achieved. Good pass coverage for all

ILRS prioritized satellites is desirable. Operators need to be encouraged to work towards that goal.

Of course an extra system at most sites would be beneficial to meeting scheduling demands. A move towards khz ranging at the MOBILAS sites would probably enhance productivity.

To aid scheduling we would always encourage feedback from end data users. Are we currently getting enough data to be useful? Conversely is there such a thing as too much data – are some of our efforts wasted when we could be selecting other targets?

Scheduling pressures are only going to increase – let's hope we can manage the problem efficiently.