Tier 1 proposal and runs

Zeljko's proposal:

https://confluence.lsstcorp.org/pages/viewpage.action?title=Cadence+Considerations+for+August+2014+workshop&spaceKey=PS

Table of runs:

https://confluence.lsstcorp.org/display/SIM/Cadence+Workshop+Simulated+Surveys

Tier 1 Simulations as suggested by Zeljko

- == Tier I ==

  1) do uniform cadence, and no other proposal

  2) do only uniform cadence but do not require pairs of visits

  3) as baseline cadence, but do not require pairs of visits

  4) as baseline cadence, but require 3 visits per night (instead of 2 in a pair). We can use the same window function for both 1-2 visits and 2-3 visits.

  5) as baseline cadence, except that the u-band exposure time is 60 sec instead of 30 sec. Nvisit for the u band remains the same

  6) as baseline cadence, except that the u-band exposure time is 60 sec instead of 30 sec. Nvisit for the u band is decreased by a factor of 2

  7) as baseline cadence, except for the shorter visit exposure time: 20 sec instead of 30 sec

  8) as baseline cadence, except for the longer visit exposure time: 60 sec instead of 30 sec

  9) "Pan-STARRS like cadence": do uniform cadence, and no other proposal, keep pairs of visits, but increase the area to include everything with Dec <+15 deg (about 27,400 deg2) (and keep the default airmass limit of 1.5)

  10) as baseline cadence, except for the more relaxed airmass limit: 2.0 instead of 1.5

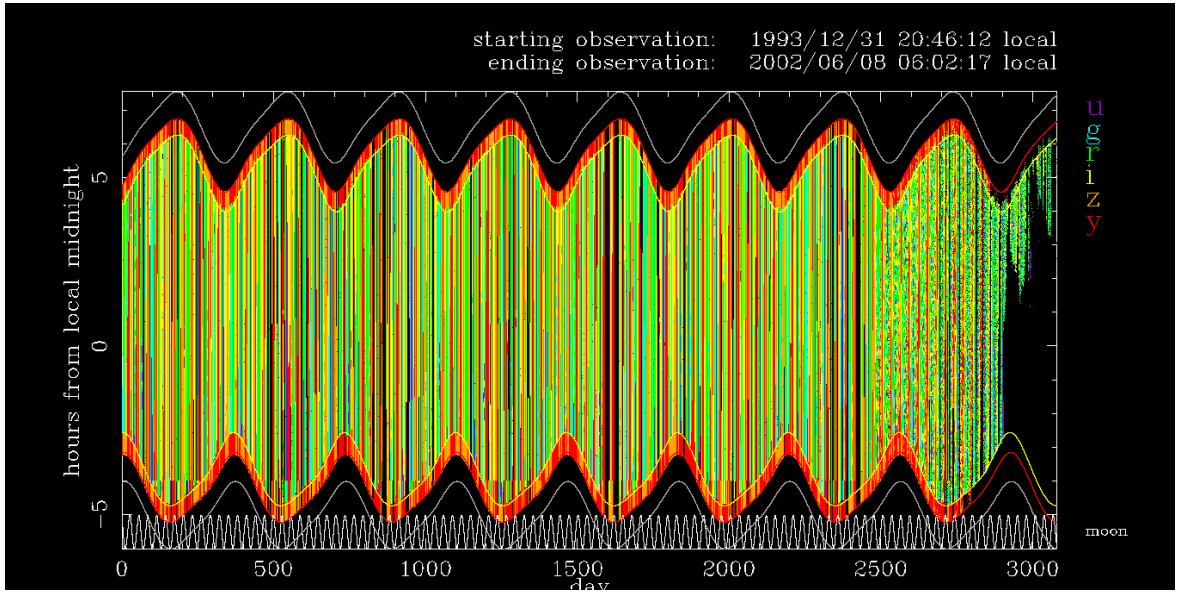
  11) as case 1) (uniform cadence with no other proposal), except for the more relaxed airmass limit: 2.0 instead of 1.5

  12) as case 1) (uniform cadence with no other proposal), except for the more stringent airmass limit: 1.3 instead of 1.5

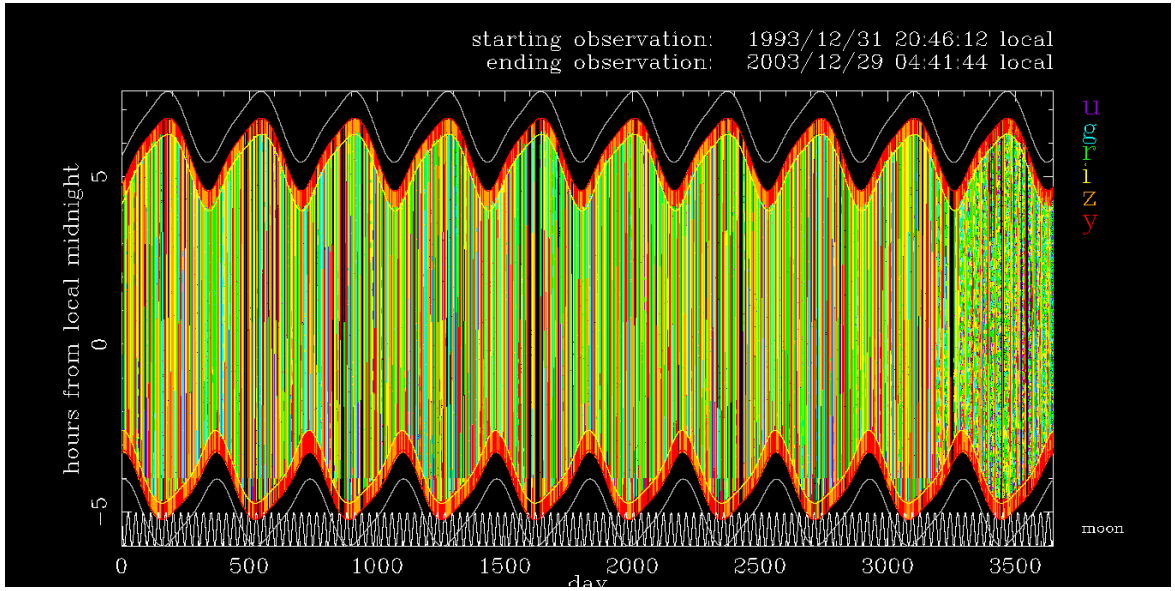
General Observations

1) Design area & design visits take ~80% of time
2) Tier 1 runs have WFD visits boosted to 75,105,240,240,210,210 in u,g,r,i,z,y to fill 10 year survey instead of 56,80,184,184,160,106 (SRD)—overflow bug remains to be fixed.
3) Asking for WFD design visits in NES is overkill

WFD @SRD visits & area finishes in 8



WFD only w/ design area and design visits finishes in 8 years



Boosted visits fills in survey time

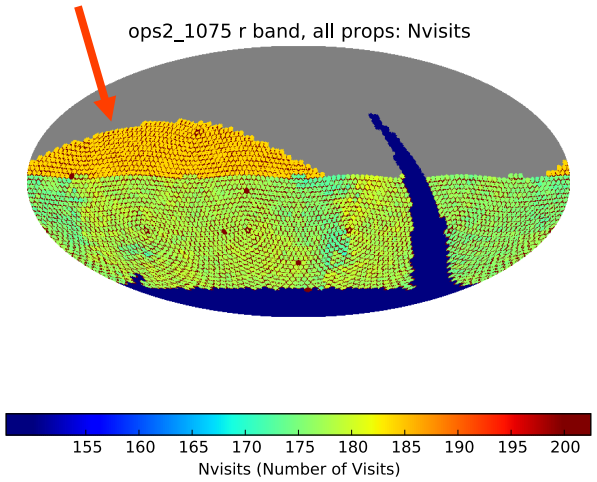
1 Candidate new baseline cadence

We need a replacement for the current baseline cadence (opsim3.61) produced with the new (v3.0) version of OpSim code

Current candidate: ops2.1075

- 2.51 million visits (2.65 in opsim3.61); OK
- mean slew time: 6.5 sec; OK
- For WFD: the mean number of visits is 99% of the SRD design value
- satisfactory airmass distribution
- problem: as much as 12.7% of time spent on North Ecliptic Spur (NES)
- 1075 has design area and design visits
- 3.61 has stretch area and stretch visits

It is unlikely that ops2.1075 will replace opsim3.61. We need to try again and de-emphasize the NES more. ops2.1079 (no MAF analysis yet) has better WFD temporal uniformity, but still needs less NES.
Check the confluence page (Cadence Workshop Simulated Surveys) for updates.



2 Maximum performance for the main survey

By what factor could we exceed the SRD design specification **for the number of visits** if only Universal Cadence proposal was implemented?

ops2.1064

- Exceeded the design specification for the number of visits by **56%** (1050 visits without dithering, 1283 with perfect dithering) over the design specification for the sky area of 18,000 sq.deg.

By what factor could we exceed the SRD design specification **for the sky coverage** if only Universal Cadence proposal was implemented with the design specification for the number of visits?

ops1.1144

- This "Pan-STARRS-like" cadence results in a **48%** larger sky coverage (26,600 sq.deg.), with the mean number of visits at 92% of the SRD design specification.

How much 'extra' time would be available in a 10 year survey if only use the WFD

ops2.1040

- When running the WFD with design visits and design area, survey is complete after 8 years—extra 20% used for auxiliary proposals in baseline cadence.

3 Effects of auxiliary programs

What is the effect of auxiliary proposals (deep-drilling fields, North Ecliptic Spur, etc.) on surveying efficiency?

- A comparison of simulations ops1.1140 (all proposals) and ops2.1064 (only WFD) shows that the former has higher surveying efficiency by about 3.4% due to shorter slewing time (6.7 sec vs. 8.2 sec). Note, the Pan-STARRS-like, WFD only, had a 7.2 sec average slew.

Adding “more choices” for the “next field” improves the survey efficiency by 4%.

4 Effects of requiring pairs of visits

What is the effect of the requirement for visit pairs (two visits per night to the same field, separated in time by about an hour, and driven by asteroid orbit determination) on the survey efficiency?

ops2.1065

- compared to ops2.1064, which was also WFD-only simulation and required pairs of visits, this simulation obtained 2% more visits due to shorter slew times.

ops2.1066

- compared to ops1.1140, with all proposals and requiring pairs of visits, this simulation obtained 2.3% more visits due to shorter slew times.

Relinquishing the visit pair requirement results in about a 2% improvement of the surveying efficiency.

“Trepanier" 3% effects (ala Zeljko)

3% changes of the surveying efficiency:

- additional proposals with DWF
- the visit pair requirement
- 1 second per visit
- 10 nights per year
- 3% of time -> depth: 0.015 mag
- six dead CCDs

5 Effects of varying visit exposure time

Can the effects of variations of the visit exposure time on the surveying efficiency be predicted using simple efficiency estimates?
E.g. the visit efficiency for baseline cadence is 30/(34+6.7)=74%

- A comparison of simulations ops1.1140 (baseline with 30 sec visit exposure time) and ops2.1072 (20 sec) confirms a simple estimate of the efficiency decrease by 12% (3.32 million visits)

- A comparison of simulations ops1.1140 (baseline with 30 sec visit exposure time) and ops2.1074 (60 sec) confirms a simple estimate of the efficiency increase by 15% (1.43 million visits)

The effects of variations of the visit exposure time on the surveying efficiency can be predicted using simple efficiency estimates.

6 Improving the u band performance

The contribution of read-out noise in the u band for 30 sec exposures is not as small as in other bands because the sky is much darker. Doubling the visit exposure time in the u band would mitigate this effect and result in 0.2 mag deeper coadded images (assuming the same total exposure time). What is the impact on the survey efficiency? What if the number of visits is not halved?

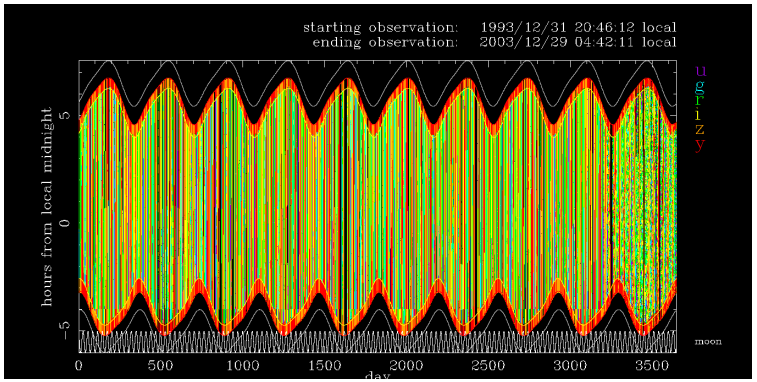
- simulation ops1.1147 shows that doubling the u band exposure time, while halving the number of u visits, decreases the survey efficiency by 3.8% (This result needs to be checked because the visits were SRD numbers—not boosted.)
- simulation ops1.1141 shows that doubling the u band exposure time, while keeping the number of visits unchanged, results in 9.5% fewer visits in other bands. Thus, the u band coadded depth could be improved by 0.6 mag at the expense of 0.04 mag shallower data in other bands

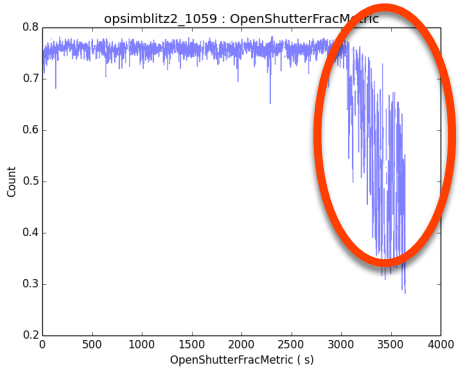
7 Effects of airmass limit and a 'feature'

The current baseline cadence places a hard limit on airmass, X<1.5.
Is this optimal value?

- Simulations using airmass limits of 2.0 and 1.3 (ops1.1146 and ops2.1068 & 1069) show that the median airmass is controlled by the airmass limit. Relaxing the latter is thus a bad idea! The baseline cadence should be produced with a smaller airmass limit (X<1.25 or X<1.30).

- **"The 10th-year Panic"** effect: some simulations, e.g. ops1.1065, 1068, 1069, display a significant decrease of the surveying efficiency during the 10th year of the survey. It seems that vigorous filter change activity is happening, though longer slew time could be responsible too. Needs more analysis!





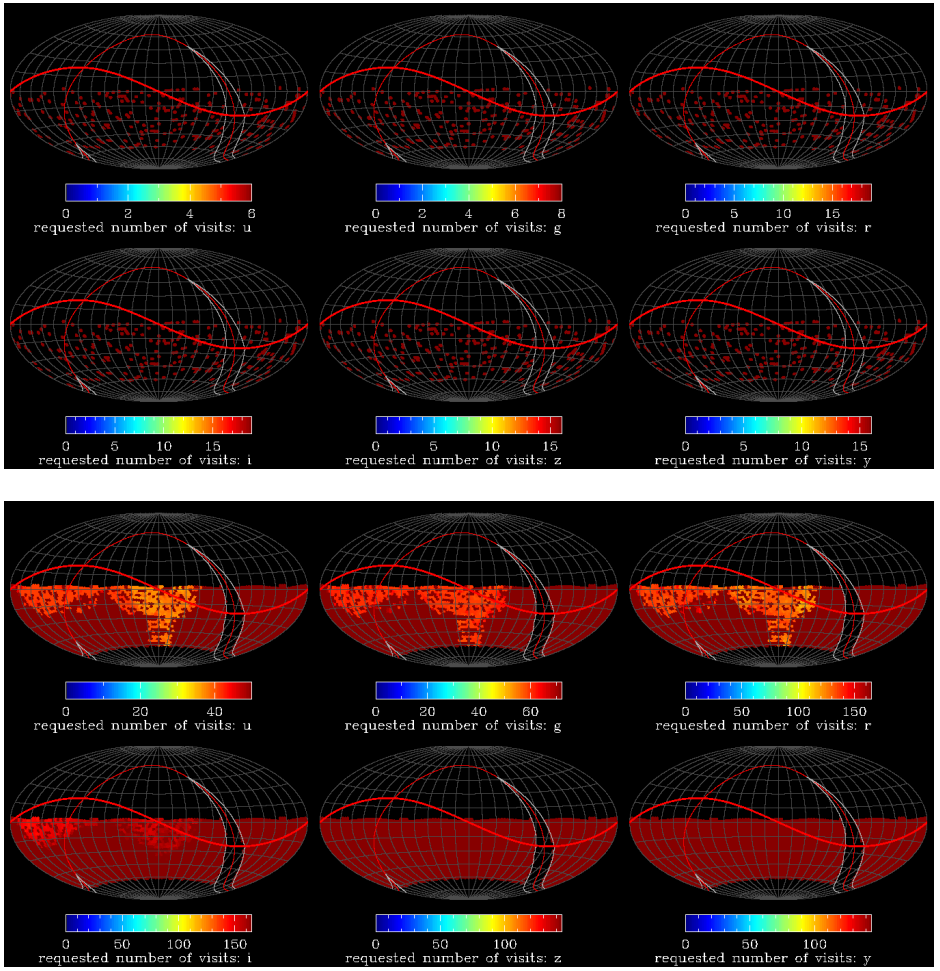
Rolling Cadences

- ‘Rolling cadences allow different time sampling over limited area and over limited time. They are motivated by trying to yield better SN light curves and variable star light curves’
- The seemingly straightforward rolling cadence of defining RA and Dec limits for a more densely sampled survey over some portion of the total survey, yielded 3 subtle bugs in the operation simulator. All of these have been fixed.
- The ‘swiss cheese’ model for a rolling cadence is on the confluence page as ops1.1122 and ops2.1078. This simulation has 10 proposals which run for different 1 year periods with $1/10^{th}$ the number of fields and $1/10^{th}$ of the total, SRD, visits. And there is a continuous WFD with 90% of SRD visits requested. These simulations are early tests. Probably need more continuous WFD when only running WFD tenths and continuous WFD.
- Mixed cadences with different cadences in rolling areas have yet to be investigated, but are similar to some Deep Drilling proposals

Rolling Cadence—Swiss Cheese

- 'Random 1/10th of WFD fields whose proposal is active for 1 year with an arbitrary cadence (say optimized for 60 day light curves). There are 10 of these.

- WFD proposal with 90% of SRD visits requested running for all ten years.



Summary

The most important conclusion of this preliminary cadence exploration is that the upper limit on possible efficiency improvements for baseline cadence is not larger than 10% and probably close to 6%. This conclusion is by and large based on the fact that the mean slew time for (candidate) baseline cadence is 6.7 sec, and thus only slightly larger than the design specifications for the system slew and settle time of 4.5 sec. Nevertheless, it is likely that the performance for time-domain science can be significantly improved (e.g. rolling cadence for SNe survey).

All tier 1 runs need to be rerun with opsim v3.2 which will be released 10/24/2014.

- Palpy used not slalib
- RA limit fix for rolling cadences
- Scheduled downtime correction (1.15% more downtime)
- Bug fixes not affecting tier 1 runs
- Utilize restart ability for WFD fields (new in v3.0, but not used in tier 1)
  - workaround for overflow bug