Proposing a feature-based scheduler for the Large Synoptic Survey Telescope

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1 Introduction

- Challenges of scheduling a telescope in general
- Review Spike (Hubble space telescope scheduler) [1], Look-ahead technique for space telescope scheduling [2], minimizing conflicts [3]
- Transition from space telescope to ground-based telescope : (1) how constraints are different, (2) why there hasn't been much work for ground based scheduling *(if that's true)*(not fast enough not expensive enough, accessible for human intervention, narrow ranged mission objectives)
- Review the scheduler of recent comparable ground-based telescopes (E-ELT, and ?, ?)
- LSST specifications and general desirables, why lsst needs an automated scheduling approach (it's expensive, fast, and has conflicting objectives)
- Characteristics of a scheduler for a ground-based telescope (computational aspects, controllable for science measures, responsive to the weather's unpredictable changes)
- Review Opsim scheduler [4]
- What Feature-based scheduler has to offer

2 Scheduling framework

This section is planned to be written in the full extent, if it became unnecessarily long, we can always use it for the other paper, and summarize it here

- Markovian representation
- Optimality conditions (history and future independence)
- Measurability conditions (on the sigma algebra of the decision making process)
- Optimal structure (min cost(i,f)), Linear/quadratic structure of cost
- Reduced optimization problem from policy to vector
- Optimizer
- Challenges to reach optimality (features would not contain all the information, cost function is structured, optimization is non-linear)

3 Region-Dependent Basis function

Illustrate that a number of simply designed basis functions can provide the scheduler with fine and tunable behavior (also in the abstract)

3.1 Basis Functions common values

this section is going to be around 8 pages long, we might as well publish the details in a tech report and then cite it here
Different regions of the sky require different visit and revisit constraints and priorities. Therefore, to evaluate a cost of operation for fields of each region there are different basis functions, that at the same time are required to be scaled appropriately, so that there will be no priority given to a certain region only due to the design of the basis functions. In this section we introduce a set of functions that are shared among the basis functions of the different regions, to provide a similar base value for all of the regions.

4 Scheduler optimization

Demonstrate how much the optimization part matters with the results of applying the solutions of earlier iterations

4.1 Differential Evolution

4.2 Objective Function

5 Simulation Results

count diagrams, Open shutter fraction, meridian observation

6 Discussion

In line with the amount of telescope's time/money it would save

References

[1] Mark D Johnston and Glenn Miller. Spike: Intelligent scheduling of hubble space telescope observations. *Intelligent Scheduling*, pages 391–422, 1994.

[2] Norman Sadeh. Look-ahead techniques for micro-opportunistic job shop scheduling. Technical report, DTIC Document, 1991.

[3] Steven Minton, Mark D Johnston, Andrew B Philips, and Philip Laird. Minimizing conflicts: a heuristic repair method for constraint satisfaction and scheduling problems. *Artificial Intelligence*, 58(1-3):161–205, 1992.

[4] Francisco Delgado and Michael A Reuter. The lsst scheduler from design to construction. In *SPIE Astronomical Telescopes+ Instrumentation*, pages 991019–991019. International Society for Optics and Photonics, 2016.