Ten minutes on several topics related to sky tiling

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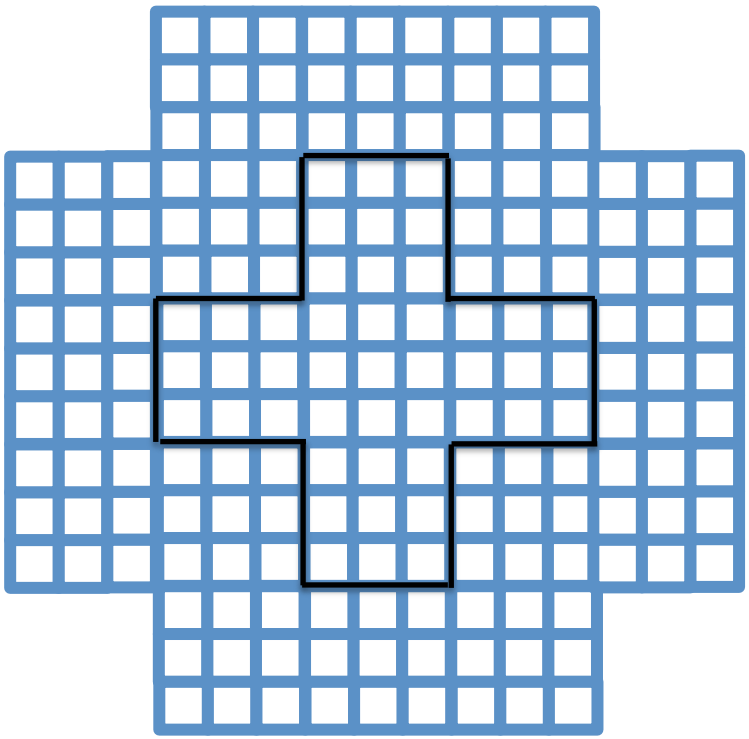
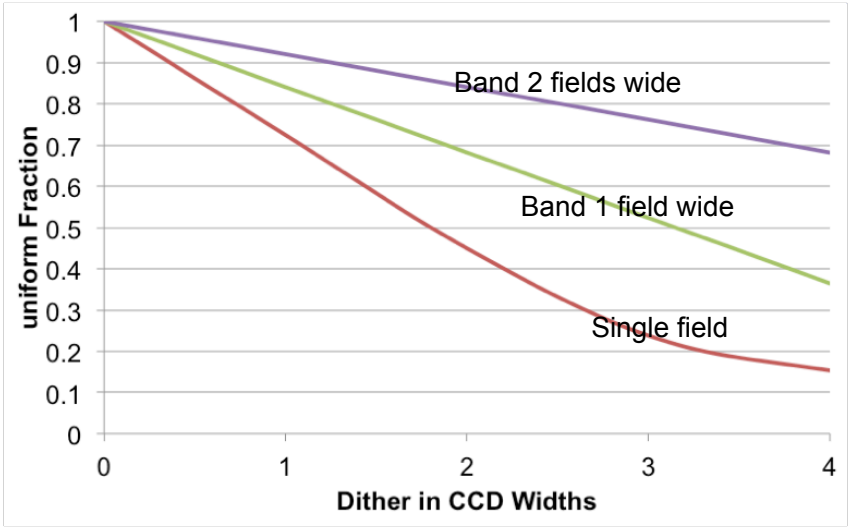
Topics

- the efficiency loss with dithering
- the problems of achieving uniformity of various types with dithering
- the benefits/costs of achieving equal depth in all exposures
- some comments on randomizing optics angles

Efficiency cost of dithering





Relevant to:

- Deep drilling
- Galactic plane
- Rolling cadence
- Repeat observation

Other costs of dithering

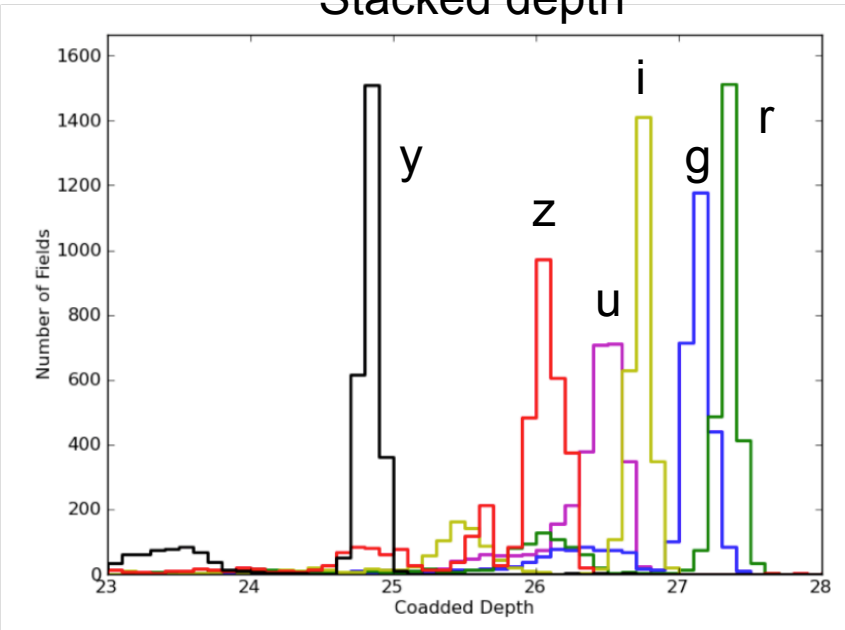
- For area filling, a band of width related to the dither distance around the edge of the area will have *reduced coverage*.
- *Uniformity of depth will be compromised* by the acquisition of partially overlapping images of different depth.
- *Time sequences* must either use the same dither for all members of a sequence, perhaps violating dither rules, or acquire additional images in order to cover required area with dithered image positions.
- A requirement to obtain at least one image of *exceptional image quality* for all parts of the sky will "waste" some high quality time, unless a standard dither position is "reserved" for the high quality acquisition.
- A requirement to obtain a minimum number of images for each part of the sky with *any given condition* (e.g. minimum air mass, fixed HA range, etc) will waste some such time unless certain dither positions are reserved for those observations.
- The extremely high S/N of *differential photometry* may not be available with dithered regions.

Achieving uniformity in multiple parameters with dithering

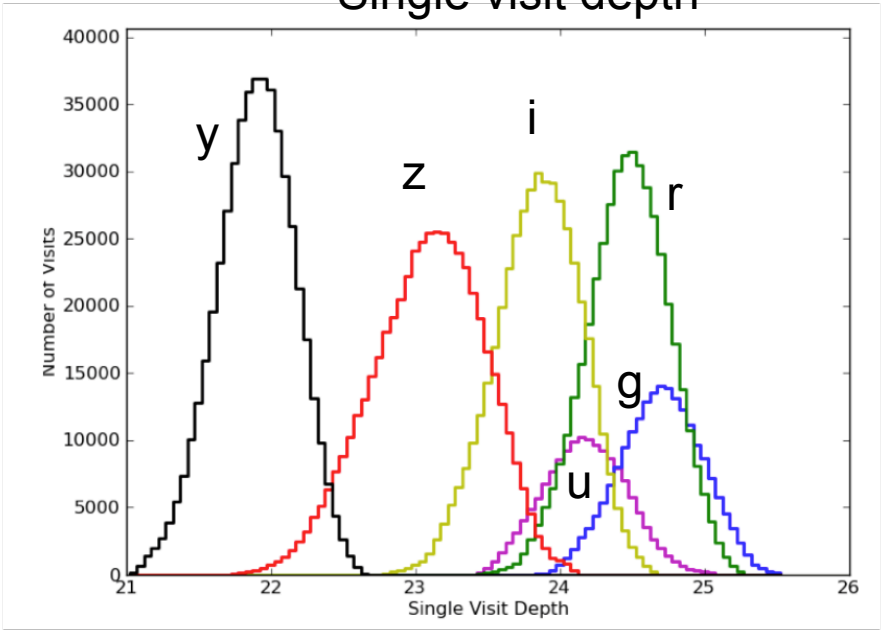
- With no dithering, each field can be re-visited to adjust uniformity with respect to other fields.
- With aggressive dithering and random rotation angles the number of differently observed spatial regions quickly becomes greater than the number of remaining exposures - then adjustment to uniformity is not possible, even if it were practical.
- Conclusion – uniformity must be assured at the time of acquisition of each image.

Uniformity of depth – the problem(s)

Stacked depth



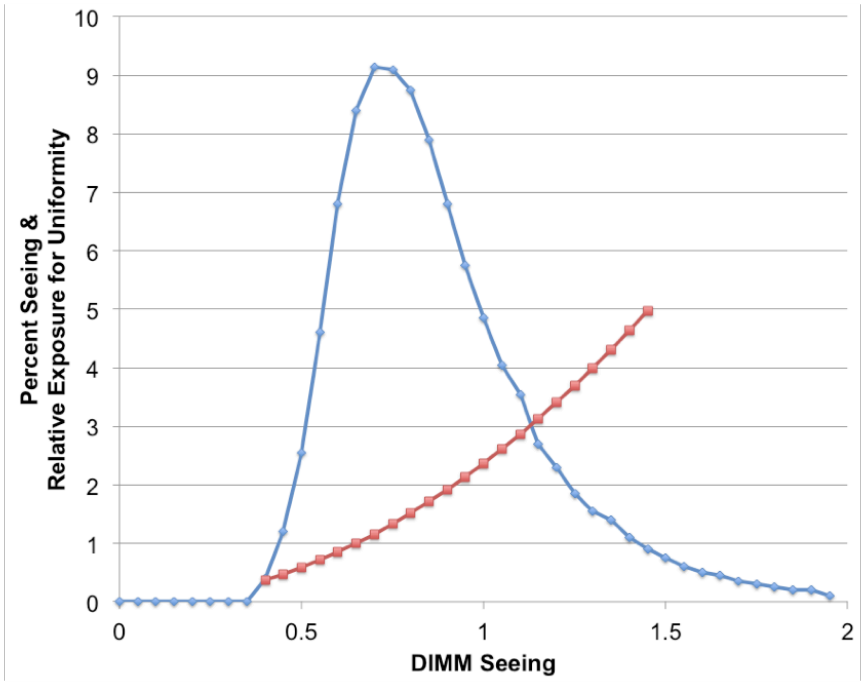
Single visit depth

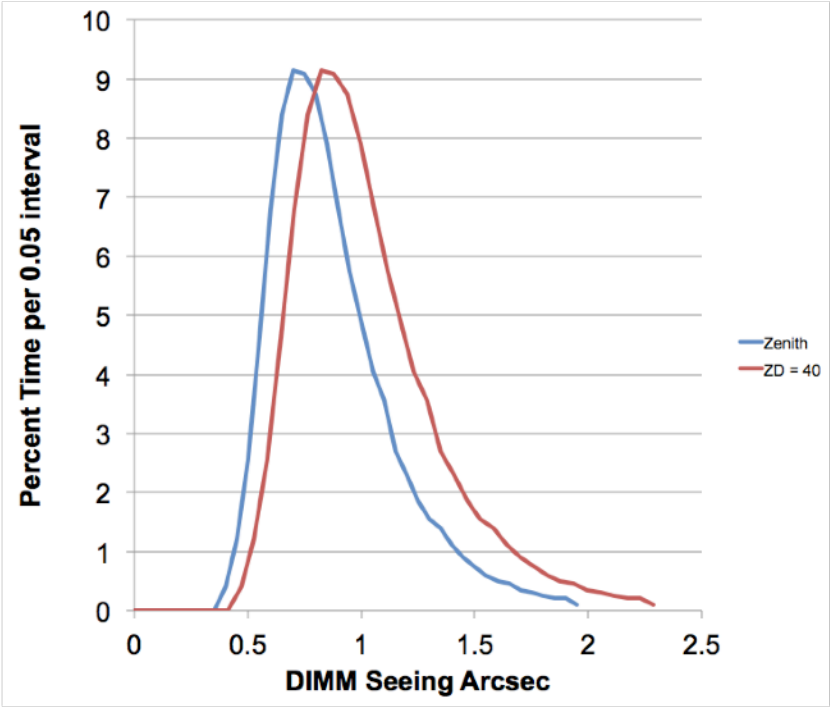


What effects cause variable depth?

- Seeing
- Zenith distance
- Sky brightness
- Transparency

Seeing and zenith distance



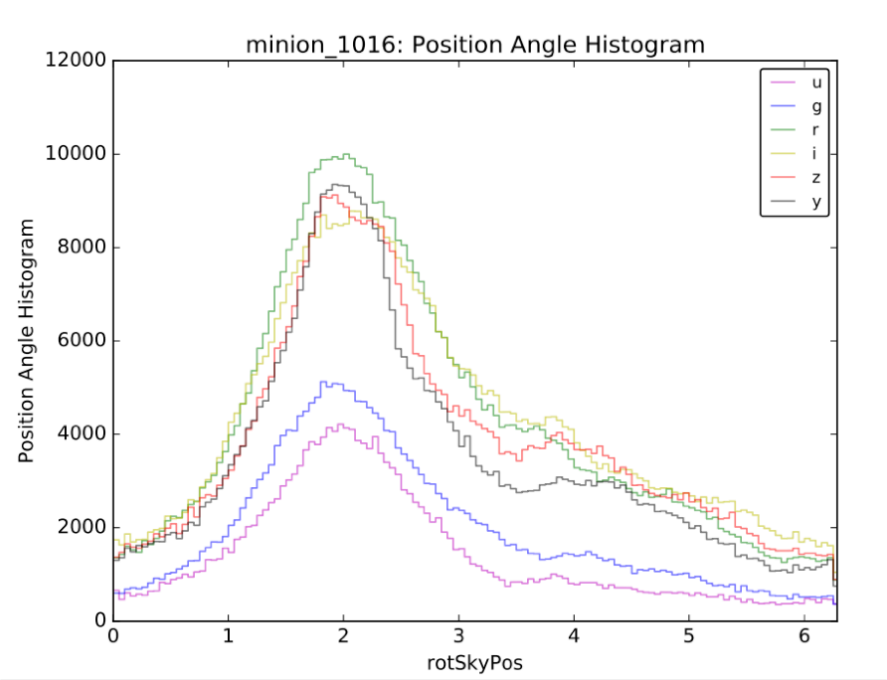


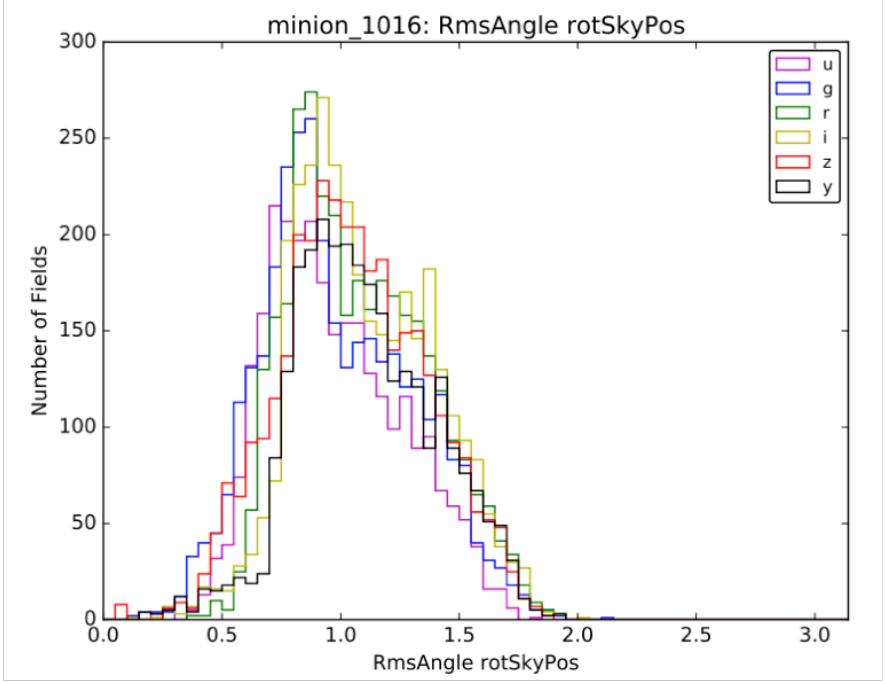
Flattening DIMM seeing curve by adjusting exposure lengths
Will reduce total number of exposures by ~40%

Costs of imposing uniform depth

- Best seeing will be used to “salvage” poor seeing conditions, rather than to provide exceptional data
- Total number of visits will be reduced
- Designing cadences will be more complex
- Cadences will not be fully predictable

Rotation Angle Randomization – The Problem





To improve randomization

- Actively randomize start position after each filter change (low cost in efficiency)
- Actively drive rotator as needed between visits (high cost in efficiency)
  - Example – if it is necessary to drive rotator by 20 degrees between visits, this will require at minimum 11 seconds, ~2X the typical slew time
  - If required for 10% of visits, this would “waste” ~75 nights of observing time

Suggested Considerations

- Actual uniformity is a fiction
- Uniformity is a reasonable ideal, but not a realistic requirement
- Improvements in uniformity are increasingly expensive as uniformity is approached
- If uniformity is a priority, think in terms of acceptable deviations from uniformity
- Be prepared to motivate numbers in detail
- Similar considerations for randomization