Low-cost Computational Astrophotography

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Dataset

• 30 photos of star streaks from Google Images

• All images included celestial pole in photographs

• Performed image preprocessing (removed watermarks, etc.)

• Varied parameters such as foreground and background elements, amount of star streaks, illumination, and noise.
Image Processing Pipeline

**Image Segmentation**
- Thresholding
  - Global
  - Otsu’s method
  - HSV conversion
- Patch Removal
- Width estimation of star streaks
- Combine independent methods

**Streak Modification**
- Identification of celestial pole
- Recursive clustering algorithm in polar
- Cluster Compression and Placement

**Postprocessing**
- Filling Holes
  - Linear interpolation
  - 2D averaging
- Denoising
  - Bilateral Filtering
Thresholding

Global thresholding  HSV-based thresholding  Otsu’s method
Patch removal + width estimation

Without patch removal

With patch removal

Width estimation
Streak modification

Star streaks in polar coordinates

Clustering algorithm, post-compression

Replacement in original image
Postprocessing: Filling holes

Star streaks removed

Linear interpolation + 2D averaging
Postprocessing: Denoising

After interpolation
Average variance: 2.68e-3

After bilateral filtering
Average variance: 1.04e-3
Sample results

Original image

Processed image
Sample results

Original image

Processed image
Sample results

Original image

Processed image
Future work

• Obtain self-taken images to test image processing algorithm

• Potentially use machine learning to segment star streaks

• Investigate more effective clustering methods

• Test other techniques for filling holes in images