

Aligning the Stars - Aurora Localization via Star-Trails

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April 28, 2013

1 Introduction

2 Determining Camera Orientation

2.1 Star Matching via Least Squares

2.2 Tracking Velocity of Earth

2.3 Star-Trails

3 Computational Method Outline

A brief description of the method that was used to determine the orientation of the camera relative to the International Space Station, which stays constant for an entire video sequence, is as follows:

1. Segment images into 'earth' and 'sky' using k-means
2. Extract the brightest stars from each frame
3. Stack extracted stars to form star-trails
4. Calculate the length of each star-trail and convert to velocity data
5. Determine the angular offset of the camera from the ISS orbit

Once the orientation of the camera relative to the International Space Station has been determined, the approximate location of the aurora in each image is placed on a map using the following method:

1. Approximate where the aurora is in the image via segmentation
2. Calculate the area of the earth visible in the image
3. Project the approximate location of the aurora onto the earth

The details of these methods will be explained further below.

3.1 Image Segmentation

3.1.1 k-means

3.1.2 Level Sets

3.2 Star-Trail Creation

3.3 Velocity Extraction

3.4 Camera Orientation Calculations

3.5 Projections and Display of Map

4 Conclusion

5 Acknowledgements

Our team wishes to thank Jeff Orchard for the implementation of Level Sets Segmentation and the wonderful Medical Image Processing course notes, the ISS Crew for the beautiful pictures, and the Toronto SpaceApps Team for organizing the Toronto Nasa SpaceApps Challenge.