Neural Network Approach to Star Tracking

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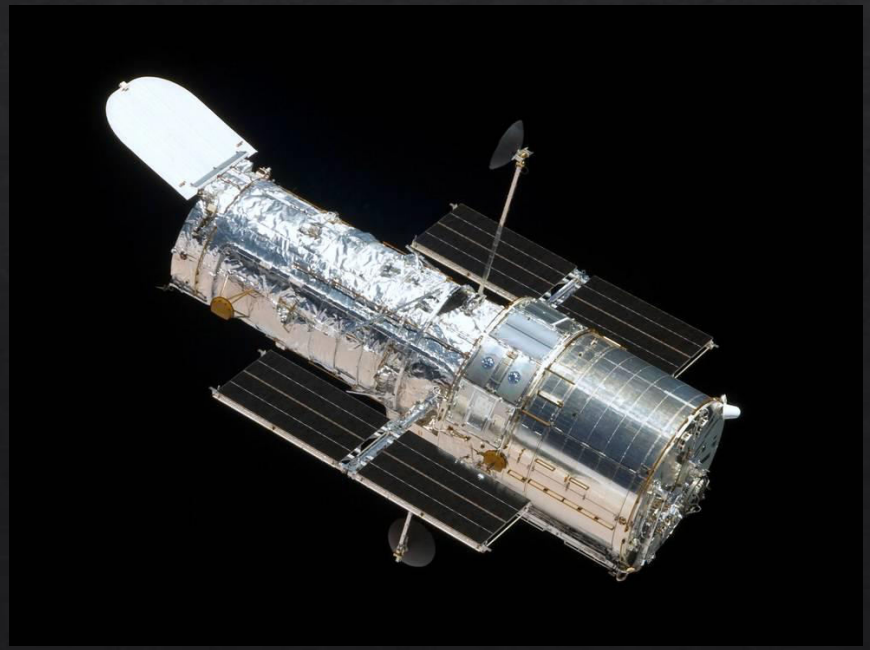


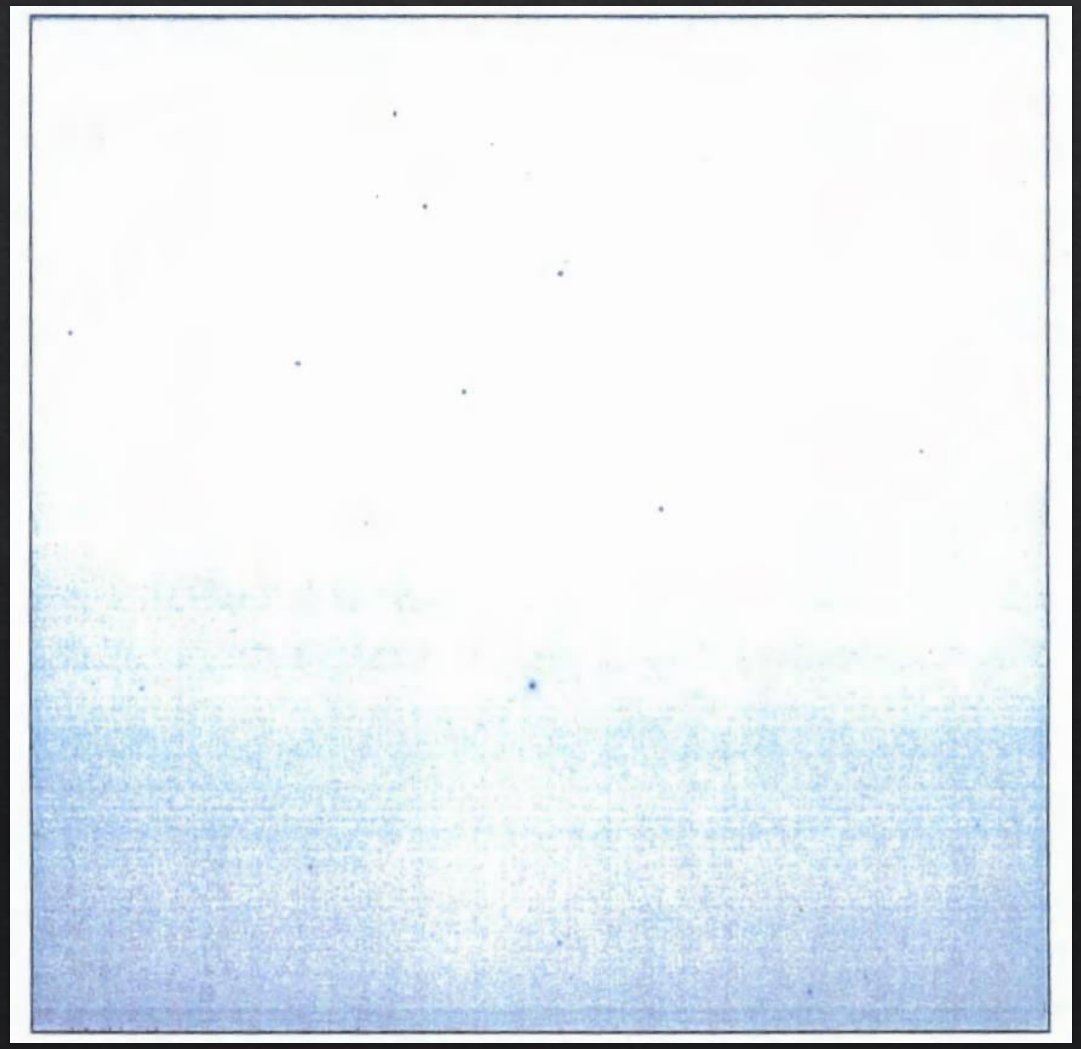
Problem Motivation

- Star tracking an extremely accurate method for satellite attitude determination
- The only method of consistently solving the "lost in space" problem

- Current problem with star trackers? Too expensive for small missions!
- Inexpensive star tracking systems at least $100,000
- Costs from small tolerances in lens design + need for robustness in harsh operating conditions.

Citations:
https://www.berlin-space-tech.com/portfolio/iadcs/
https://www.berlin-space-tech.com/portfolio/1913/
https://www.cubesatshop.com/product/nst-1-nano-star-tracker/

Example of Star Tracking Image



Problem Statement

- Neural networks extremely effective at image recognition (Krizhevsky 2012)
- Most research on neural networks trained to identify stars from the early 2000's
- Want to implement modern ML techniques to star identification

- First step, apply CNN to the task of star recognition
- Later, develop the system to be robust to lower quality cameras and lenses to allow for less expensive star tracking systems

References

- Li, C., Li, K., Zhang, L., Jin, S., & Zu, J. (2003). Star pattern recognition method based on neural network. Chinese Science Bulletin, 48(18), 1927-1930.
- Hong, J., & Dickerson, J. A. (2000). Neural-network-based autonomous star identification algorithm. Journal of Guidance, Control, and Dynamics, 23(4), 728-735.
- Trask, A. J. (2002). Autonomous artificial neural network star tracker for spacecraft attitude determination (Doctoral dissertation).Ho, K. (2012). A survey of algorithms for star identification with low-cost star trackers. Acta Astronautica, 73, 156-163.
- Spratling, B. B., & Mortari, D. (2009). A survey on star identification algorithms. Algorithms, 2(1), 93-107.
- Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). Imagenet classification with deep convolutional neural networks. In Advances in neural information processing systems (pp. 1097-1105).