



***The Aerospace Corporation  
Civil Systems Group (CSG)***

***Overview of AI at Aerospace***

***Jon Neff***

***Civil Systems Group  
Artificial Intelligence Team***

***November 2018***

Approved for public release. OTR 2019-00056.



# AEROSPACE BY THE NUMBERS

**3,900**  
Employees

**73% TECH STAFF**  
**Over 750 Ph.D.'s**

**53%**  
Military Space

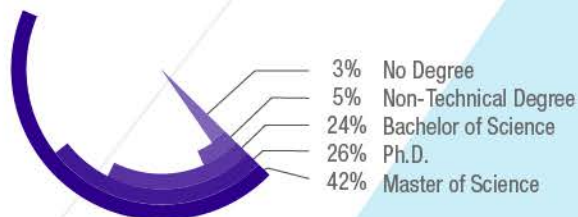


**35%**  
Intel Space

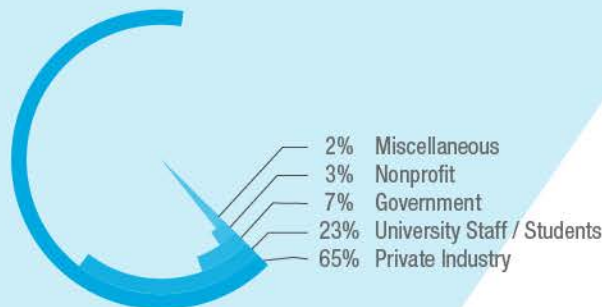
**12%**  
Civil and Commercial

## TECHNICAL STAFF DETAILS

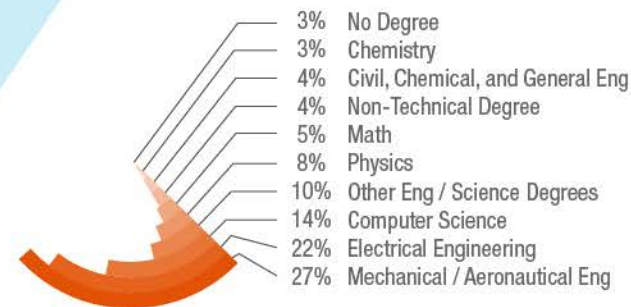
### DEGREES OF TECHNICAL STAFF



### PREVIOUS AFFILIATIONS OF TECHNICAL STAFF



### DISCIPLINES OF TECHNICAL STAFF



**Aerospace is a non-profit corporation operating an FFRDC dedicated to space mission success.**





# AI and Analytics at Aerospace

CSG AI Team coordinates across Aerospace to deliver innovative solutions

Awards

**Aerospace SeedTECH AI advanced to 2nd round of the IBM Watson \$5M XPRIZE**

**Aerospace won the Army Rapid Capabilities Office Blind Signal Classification Challenge**

Projects

## Object Detection

*Robust Positioning /  
Navigation / Timing*

*Overhead Imagery  
Analysis*

*Additive  
Manufacturing*

*Hyperspectral  
Imaging*

*Near-Earth Object  
(NEO) Detection*

## Intelligent & Autonomous Agents

*Intelligent Power  
Systems*

*Autonomous Satellite  
Agents*

*Assured Operations  
of Autonomous  
Systems*

## Prediction & Anomaly Detection

*Rocket Telemetry  
Analysis*

*GPS Anomaly  
Detection*

*Satellite as a Sensor*

*Cyber Security*

*Counter-Poaching*

## Programmatic Support

*Predicting Mission  
Cost and Schedule  
Performance*

*Portfolio Optimization  
and Management*

*Mission Risk  
Classification*

*Document Mining*

Skill Sets

## Solid Foundation in AI, Machine Learning & Advanced Analytics

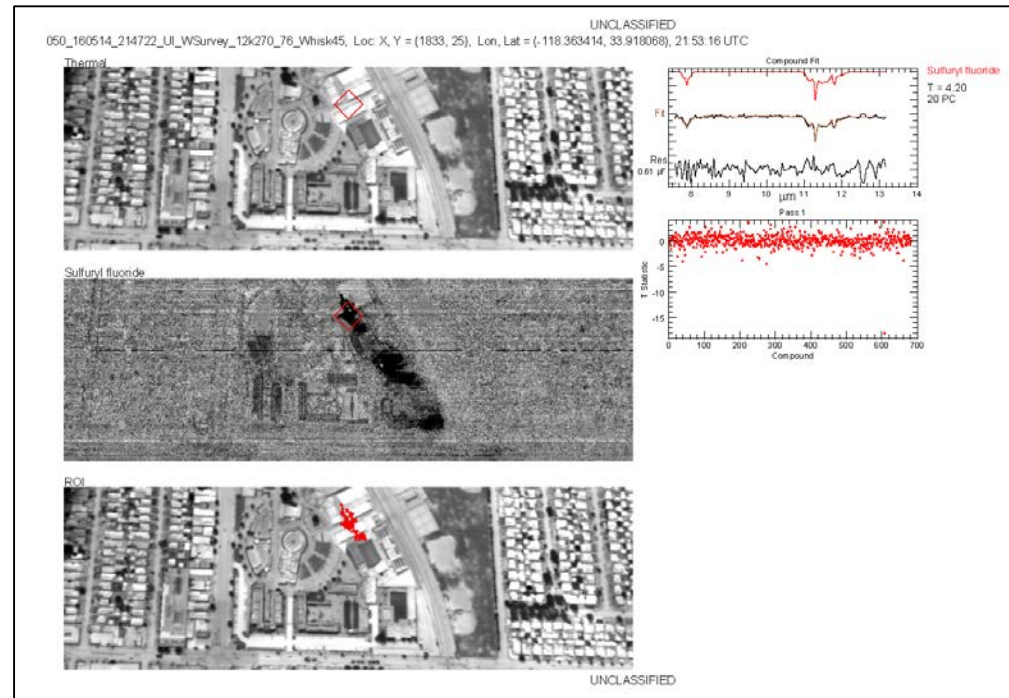
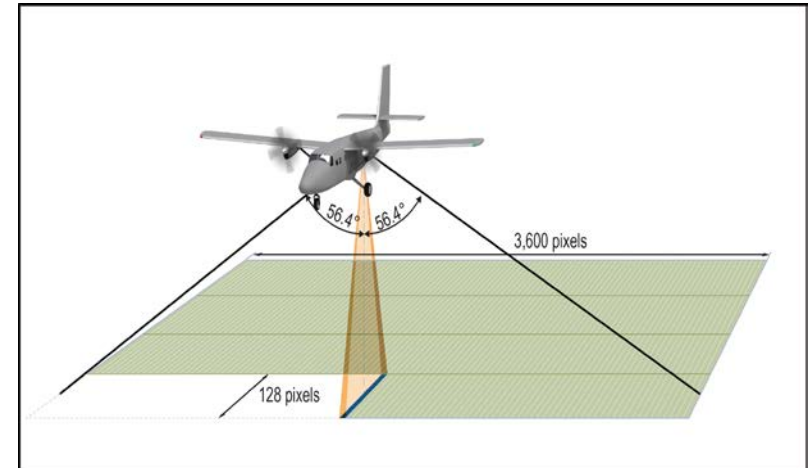
*Statistical Modeling, Computer Vision with Deep Convolutional Neural Networks (CNNs), Anomalous Signal Processing with Recurrent Neural Networks (RNNs), Natural Language Processing (NLP), Hierarchical Temporal Memory, Containerization, Infrastructure and Streaming Platforms for Ground Systems and Telemetry, ...*



# Hyperspectral Imaging

Andrew Brethorst, Information Systems and Cyber Division

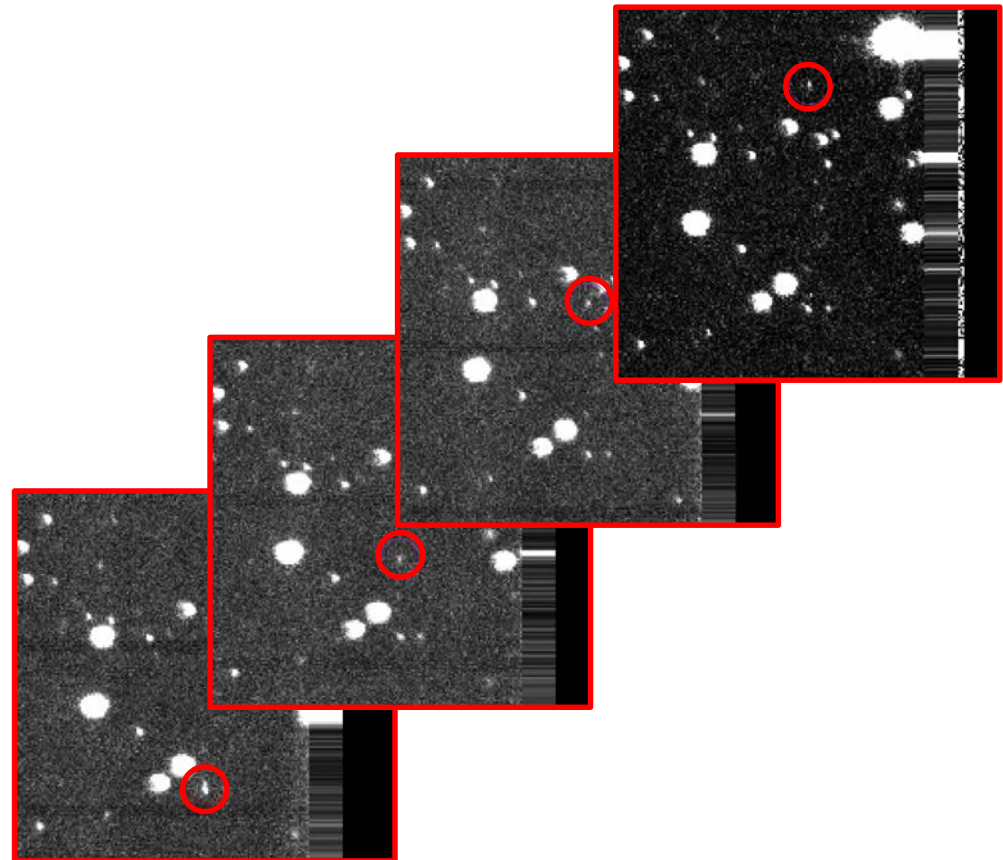
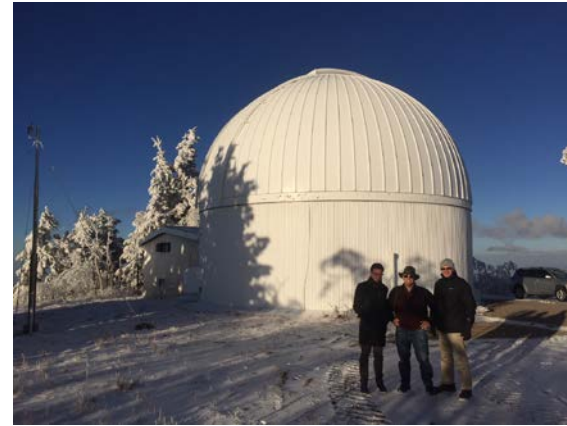
- HSI data collected from Mako sensor on Twin Otter aircraft
  - 128 bands
  - Large data captures
- HSI identifies chemical compounds in hyperspectral images (HSI)
  - Gasses and solids
- Previous approach had a 90% false positive rate
  - Human analysts required to sift through large amounts of data
- Utilized deep learning to improve accuracy and data throughput
  - 65% reduction in false positives
  - Reduced processing time from 40 to 16 hours
  - Reduced analyst time from 4 to 1.4 hours



# Near Earth Object Detection

*Civil Systems Group AI Team*

- NASA funds Catalina Sky Survey at the University of Arizona to identify Earth-crossing asteroids.
- Current detection process relies on a semi-automated approach with human observers looking at thousands of images per night to validate NEO candidates.
- Combined two models to reduce false positives and improve NEO detection rate
  - *Xgboost on metadata*
  - *CNN on image data*
- Initial results: expect increase of ~10% NEOs detected over time





# Assured Operations of Autonomous Systems

## “ResilienceNow” Testbed

### Civil Space Operations Directorate

- Challenges for numerical weather prediction
  - Increasing volume of observational data (>20TB/Day)
  - Resilience in a silo model is expensive
  - Current value chain is vulnerable
- Solution
  - Scalable infrastructure testbed for cloud-based data operations using open-source technologies: Kafka, Kubernetes, Docker
  - Autonomous health monitoring of the value chain using machine learning
  - Real-time operational impact assessment
- Objectives: demonstrate
  - Self-monitoring, self-healing, auto-scaling...in real time

