"The Ångstrom Project - Multispectral, Hyperspectral and Radiometric Investigation of Unidentified Aerial Phenomena: Instrumentation and Methodology for Comprehensive Spectral Analysis"

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ABSTRACT

The spectral study of Unidentified Aerial Phenomena (UAP) aims to capture and analyze electromagnetic emissions across the visible and infrared spectra. This project integrates advanced multispectral and hyperspectral imaging technologies to investigate UAPs over a broad wavelength range. By employing radiometric infrared cameras and hyperspectral imagers in the visible to near-infrared (VNIR) and short-wave infrared (SWIR) bands, the platform is designed to measure key physical parameters—such as thermal emissions and optical spectral signatures—in real time. From these measurements, insights may be gained into UAP propulsion mechanisms and material composition.

The Ångstrom Project outlines a strategy for real-time anomaly detection using multi-sensor integration. By combining visible and infrared spectral data with environmental context, the system enables scientifically rigorous and verifiable observations of UAPs. This study represents a significant advancement in UAP research, providing a comprehensive framework for multispectral and radiometric analysis corroborated by independent sensor modalities.

Introduction

Historical Development of UAP Spectroscopy

The study of Unidentified Aerial Phenomena (UAP), often referred to as unidentified flying objects (UFOs), has spanned more than 75 years. However, scientific approaches to understanding these events have often been fragmented. One area of increasing interest is spectroscopy—an essential technique for analyzing the composition, energy emissions, and physical characteristics of objects based on the light they emit, absorb, or reflect. Despite its potential, the application of spectroscopic methods to UAP observation has encountered substantial challenges. This section outlines the historical development of spectroscopic UAP research and traces its evolution from early observations to current multispectral strategies.

1. Early Efforts in the 1940s–1960s: Limited Technological Capability

The first recorded attempts to capture UAP data, beginning in the 1940s, were primarily visual or photographic. During this period, efforts focused on documenting sightings through still images and eyewitness reports, with limited emphasis on scientific data collection. The technology required for spectral analysis was in its infancy and largely inaccessible to those investigating UAPs. At the time, military and government agencies—particularly in the United States—began recording UAP incidents, most notably the U.S. Air Force's Project Blue Book[1–3]. However, these investigations rarely employed spectroscopic instrumentation. Observers lacked access to advanced optical systems capable of resolving spectral signatures, and the scientific community generally dismissed UAP research as anecdotal or unreliable. As a result, the spectral study of UAPs remained largely unexplored.

2. 1970s–1980s: The First Scientific Interest in UAP Spectroscopy

As technological advancements in spectroscopy and optics accelerated during the 1970s, some researchers proposed applying these tools to the study of UAPs. However, few sustained efforts emerged due to limited funding, skepticism within the scientific community, and the ad hoc nature of UAP research at the time. Despite these challenges, some private investigators attempted to use amateur-grade telescopes and cameras equipped with basic spectroscopic attachments to observe UAPs. The resulting data were often inconclusive, as the limited sensitivity of available equipment made it difficult to distinguish UAPs from background noise or atmospheric phenomena. One notable exception was the Hessdalen Lights in Norway—a long-term, scientifically documented UAP event that began in the early 1980s—which renewed interest in applying rigorous observational methods, including spectroscopy, to UAP research[4,5]. In the case of Hessdalen, some spectral data were acquired, but the results were insufficient to draw definitive conclusions.

3. 1990s–2000s: Breakthroughs in Spectral Data Collection

The 1990s and 2000s saw significant improvements in spectroscopic instrumentation, particularly with the introduction of more affordable and portable spectrometers, which expanded opportunities for field-based observations. During this period, organized efforts to apply these tools to UAP research emerged, primarily led by private organizations and independent investigators.

Hessdalen Lights Spectroscopic Studies (1990s–2000s): In Norway, the Hessdalen Automatic Measurement Station (Hessdalen AMS) was established to continuously monitor anomalous lights reported in the Hessdalen Valley[6,7]. Researchers employed both optical and spectroscopic methods to capture emissions from the lights. The data suggested energy output in both the visible and infrared ranges, although the origin and nature of the phenomenon remained undetermined.

Tethered Experiments with Balloons and Aircraft: Researchers in Europe and South America began deploying cameras and spectrometers via balloons and aircraft in regions known for frequent UAP activity. These experiments yielded some notable spectral data, including apparent correlations between sightings and unusual atmospheric conditions[8]. However, the findings were inconclusive and did not eliminate natural explanations.

This era also marked the emergence of new detection approaches, including early multispectral imaging techniques, which laid the foundation for more advanced spectroscopic studies in subsequent decades.

4. 2010s: Renewed Interest and Technological Advancements

During the 2010s, spectroscopy experienced renewed interest in the context of UAP research, driven by advancements in hyperspectral and infrared technologies. Governments and scientific institutions began to engage more openly with the subject, as demonstrated by the declassification of military encounters with unidentified aerial objects and the establishment of formal investigative efforts, such as the U.S. Department of Defense's Advanced Aerospace Threat Identification Program (AATIP)[9].

Infrared Imaging: The broader availability of infrared cameras, capable of detecting objects invisible to the human eye, encouraged researchers to incorporate these tools into UAP investigations. For the first time, infrared and thermal spectroscopy became viable methods for identifying energy emissions from UAPs. These techniques enabled the detection of temperature gradients and heat signatures potentially related to propulsion mechanisms or localized energy fields.

Integration with Environmental Sensors: As researchers increasingly recognized that UAP events could involve environmental interactions, spectroscopic instruments were integrated with complementary sensor technologies, including electromagnetic field detectors and atmospheric monitors. This multi-sensor approach helped reduce false positives caused by natural phenomena and yielded more comprehensive datasets, though conclusive results remained elusive[10].

5. 2020s: Emerging Multispectral and Radiometric Strategies

In the 2020s, the spectroscopic study of UAPs has evolved into a more structured and scientifically credible effort, supported by cutting-edge technology and increasing institutional interest. With the formation of initiatives such as the Galileo Project, the use of high-resolution multispectral imaging, radiometric infrared cameras, and advanced spectrometers has become central to modern UAP research programs[11–13].

Multispectral and Hyperspectral Imaging: Researchers now deploy multispectral and hyperspectral cameras that span a broad range of electromagnetic wavelengths, from the visible to the near-, short-wave, mid-wave, and long-wave infrared (NIR, SWIR, MWIR, LWIR). These systems are mounted on ground-based platforms and aircraft to monitor regions of the sky with frequent UAP reports. This technology enables detailed spectral analysis, allowing for assessment of material composition, thermal emissions, and surface reflectance. Data fusion across spectral bands enhances observational reliability and corroborates findings.

Radiometric Analysis: Radiometric infrared cameras provide high-precision measurements of thermal emissions from UAPs. These instruments support estimation of temperature gradients and energy output, both of which are relevant to understanding potential propulsion or energy systems. Radiometric data are often cross-referenced with optical and radar sources to construct comprehensive profiles of the phenomena.

Government and University Engagement: Growing interest from the U.S. government and academic institutions has led to increased collaboration between public and private entities. These efforts commonly employ advanced optical and spectroscopic instrumentation to collect high-quality spectral data from UAP encounters. Among the most prominent examples is the Galileo Project at Harvard University[11–13].

Table 1. Summary of Instruments Used in the UAP Observation Platform

Instrument	**Function**	**Spectral/Technical Range and Specifications**
Figspec FS23 Hyperspectral Camera	Pushbroom VNIR imaging for spectral signature analysis	400–1000 nm; 1920×1920 pixels; 1200 bands; 2.5 nm resolution; 12-bit; 25 mm, 50 mm coated HS lenses; Tokina 80–200 mm f/2.8
Figspec FS27 Hyperspectral Camera	Pushbroom SWIR imaging for UAP classification and material discrimination	900–1700 nm; 1280×1280 pixels; 1024 bands; 6 nm resolution; 12-bit; 50 mm and 100 mm coated HS lenses
Sony Alpha 7S III (No IR filter)	High-sensitivity visible/NIR tracking and spatial registration	4K video; optimized for low-light; NIR-capable; Tokina 80–200 mm f/2.8 lens
Phantom v890 High-Speed Camera	Motion tracking of fast aerial targets under low light	Up to 890,000 fps (reduced resolution); low-light capable
FLIR A655sc Thermal Camera	Radiometric MWIR/LWIR imaging of thermal anomalies	7.5–14 µm; 640×480 resolution; radiometric
All-Sky Camera (INDI-based)	Continuous environmental monitoring and meteor/UAP detection	Full-dome visible-range capture; night-sensitive
SCW Beacon 8.0 PTZ Camera	Long-range optical tracking and identification of aerial targets	4K Ultra HD; 40× optical zoom; starlight night vision; IR-cut filter; IP67-rated
GPS-Synchronized Time Server	Frame-level synchronization across instruments	<1 µs accuracy; NTP or PPS synchronized
FreeWorld Monitor + Elgato Capture	Real-time video overlay with scan box for manual targeting	HDMI overlay; visual alignment with scan slit
PlaneWave L-500 Mount	Robotic alt-az telescope mount for rapid UAP tracking and stabilization	Direct drive; zero backlash; 100 lb capacity; 50°/s slew rate; sub-arcsecond tracking precision
PlaneWave 0.5 m IDK Telescope	Optical tube for long-range visible/IR and hyperspectral targeting	0.5 m (20 in.) aperture; 3455 mm focal length; f/6.8 corrected Dall–Kirkham; carbon truss; diffraction-limited optics

Equipment Description

Hyperspectral Cameras

Hyperspectral cameras offer significant advantages over traditional imaging systems by capturing detailed spectral information across a wide range of wavelengths for each individual pixel. This capability enables not only spatial characterization but also spectral analysis, allowing for the identification of material properties, chemical composition, and subtle variations undetectable by standard RGB or monochrome cameras[14].

In the context of Unidentified Aerial Phenomena (UAP) detection, hyperspectral imaging provides the ability to analyze the spectral characteristics of each pixel within the observed object. This facilitates the detection of anomalous materials, potential propulsion mechanisms, and thermal emissions that may be invisible to traditional imaging systems. With hundreds to thousands of contiguous spectral bands spanning the visible, near-infrared (VNIR), and short-wave infrared (SWIR) ranges, hyperspectral imaging enhances object detection and classification—particularly for targets exhibiting unconventional properties or behavior. The integration of pixel-level spectral and spatial data offers a transformative capability for UAP research, enabling precise and analytically rich observations.

Two hyperspectral cameras were acquired for this study. While both pushbroom and full-frame systems are available commercially, pushbroom architectures were selected to maximize spectral resolution. Pushbroom cameras require either relative motion between the sensor and the target or a mechanical scanning mechanism to translate the slit across the scene. Although full-frame systems remove this constraint, their spectral resolution is typically limited to fewer than 300 bands. The decision to prioritize spectral resolution was a key driver in camera selection.

The first camera provides imaging across the VNIR range, from 400 to 1000 nm. It features a 1920 $\times$ 1920-pixel detector and captures 1200 spectral bands with a full width at half maximum (FWHM) of 2.5 nm. This level of resolution supports material classification and high-precision analysis. The CMOS detector has a 5.86 µm pixel pitch and 12-bit radiometric depth, offering strong dynamic range and signal-to-noise performance.

The second camera covers the SWIR range, from 900 to 1700 nm. It delivers 1280 $\times$ 1280-pixel spatial resolution and acquires 1024 spectral bands at 6 nm FWHM. Its InGaAs detector exhibits excellent SWIR sensitivity and a pixel size of 5 µm, which enhances spatial resolution relative to typical SWIR imagers. The system is optimized for surface identification, material discrimination, and remote sensing applications.

Hyperspectral imaging in low-light or nighttime conditions poses substantial challenges. Under such conditions, signal-to-noise ratio decreases significantly, often necessitating longer exposure times that are impractical for moving objects. Additionally, pushbroom systems depend on line-by-line acquisition, which limits spatial context when ambient illumination is insufficient. As a result, while spectral data may remain valid, the corresponding spatial information may be degraded or lost, complicating classification and tracking. To mitigate these issues, spatial binning at 4$\times$ was employed to increase photon throughput, accepting reduced spatial resolution in exchange for improved sensitivity. Spectral resolution remained unbinned.

To further adapt to low-light limitations, a dual-camera workflow was implemented. A high-sensitivity VNIR video camera provides real-time spatial context and target tracking, while the hyperspectral system collects slit-based spectral data. The overlay of these systems enables manual or automated alignment, allowing operators to correlate visual and spectral information effectively.

Radiometric Cameras

Radiometric cameras offer significant advantages for the detection and analysis of Unidentified Aerial Phenomena (UAP) by capturing detailed thermal data at the pixel level. Unlike standard infrared imagers, radiometric systems such as those developed by FLIR measure absolute temperature values for each pixel, enabling the identification of thermal anomalies and subtle variations in heat signatures. This capability is particularly critical in UAP research, where thermal properties may reveal insights into an object's composition, propulsion mechanisms, and energy output.

Operating across the mid-wave infrared (MWIR) and long-wave infrared (LWIR) spectral bands, radiometric cameras can detect objects with low thermal emissions or those operating under conditions in which visible and near-infrared (VNIR) sensors may be ineffective. Pixel-level thermal mapping allows researchers to characterize UAPs with greater specificity, distinguishing them from conventional aircraft, meteorological phenomena, or environmental thermal clutter. The ability of radiometric cameras to provide calibrated temperature data over wide fields of view and in varied environmental conditions makes them essential to rigorous UAP study.

This project utilized the FLIR A655sc thermal imaging system, selected for its high-resolution radiometric performance across the 7.5–14 µm range. The camera features a 640 $\times$ 480-pixel uncooled microbolometer sensor, capable of delivering accurate temperature measurements for every pixel. This spatially resolved thermal data enables detection of fine temperature gradients in complex or dynamic environments. The system's calibration and sensitivity in the MWIR and LWIR ranges make it well suited for scientific investigations of aerial thermal anomalies, including potential UAP propulsion emissions and environmental interactions.

Computing and Storage

To support high-throughput data acquisition and real-time processing during field operations, a high-performance laptop was procured for the Angstrom Project. The system is equipped with a top-tier CPU and GPU to manage simultaneous hyperspectral, radiometric, and high-speed video streams. Most critically, the internal 1 TB NVMe solid-state drive (SSD) operates at read/write speeds exceeding 7,000 MB/s, ensuring that large volumes of data—particularly from the Phantom v890 and FS-23 hyperspectral camera—can be written without bottlenecks or dropped frames. This workstation-class laptop will serve as the central control and storage hub during commissioning and field deployment.

Methods

The method for utilizing these cameras to capture baseline data begins with the systematic observation and classification of spectral signatures from known objects, such as satellites and aircraft. This process establishes a reference database of spectral signatures that can be used to differentiate between familiar and unknown targets. By deploying sensors across the visible, near-infrared (VNIR), and short-wave infrared (SWIR) spectral ranges, researchers can acquire pixel-level spectral profiles for each object. These signatures consist of characteristic patterns of reflected, emitted, or absorbed wavelengths that correspond to specific materials, thermal properties, and surface features.

The first phase involves imaging known targets in controlled and repeatable scenarios to ensure consistent data acquisition. For satellites, imaging is conducted during predicted orbital passes; for aircraft, observations encompass various altitudes and trajectories to capture potential variations due to atmospheric conditions and viewing geometries. Each object's spectral profile is recorded under diverse environmental conditions, including varying illumination, humidity, and temperature, to enhance the robustness of the reference dataset.

Once baseline data are acquired, the spectral signatures are analyzed and classified using statistical and machine learning methods. Dimensionality reduction techniques such as principal component analysis (PCA) or t-distributed stochastic neighbor embedding (t-SNE) are applied to isolate salient features and suppress noise. Processed data are compiled into a spectral library, wherein objects are categorized based on their distinctive spectral characteristics. This library serves as the foundational dataset for future comparison and identification.

When an unknown object—such as a UAP—is observed, its spectral data are collected using the same hyperspectral systems and compared to entries in the spectral library. Pattern recognition algorithms and unsupervised clustering methods are applied to detect similarities or anomalies. If the signature aligns with a known entry, the object may be classified accordingly. Conversely, if the signature exhibits substantial deviation, it is flagged for further analysis as a candidate unknown. This approach establishes a scientifically rigorous method for distinguishing between known and unknown aerial objects based on their spectral properties.

To enable synchronized acquisition of spectral and visual data, a tri-camera system was developed that integrates two hyperspectral sensors (FS23 and FS27) with a Sony Alpha 7S III full-spectrum mirrorless video camera. The Sony system delivers a low-noise, high-sensitivity 1080p feed. Its internal infrared filter was removed to ensure extended sensitivity into the NIR region. All cameras are rigidly co-mounted with aligned optical axes, ensuring overlapping fields of view. The FS23 and FS27 hyperspectral sensors each cover a narrower field of view ($\sim 3^\circ$), embedded within the broader 10° field of the Sony camera. Angular registration was verified through geometric calibration using fixed celestial and terrestrial targets.

A custom Python-based graphical user interface (GUI) displays the real-time Sony feed via HDMI capture, overlaid with a green rectangular scan box that corresponds to the FS23 field of view. A red vertical line within this box tracks the current FS23 slit position. Manual controls allow the user to initiate scans and adjust camera parameters such as frame rate, exposure time, and binning. This visualization system enables an operator to track dynamic targets and trigger spectral acquisition when the object enters the FS23 scan window.

Figure 1: Angular overlay of the FS23 field of view centered within the Sony Alpha 7S III HDMI output. The red line denotes the FS23 slit position at 40% of the scan box width.

Scan control is performed by a dedicated C# application built using the FS-2X software development kit (SDK). The graphical user interface (GUI) initiates this executable and transmits acquisition parameters. During scanning operations, the FS23 writes real-time slit position data to a shared file, which is polled by the Python-based GUI at high frequency to animate the red scan line accurately. This configuration ensures temporal and spatial coherence between visual tracking and hyperspectral data acquisition. Resulting data cubes are saved in `.spe` band-interleaved-by-line (BIL) format with ENVI-compatible `.hdr` metadata, including frame-specific angular and temporal annotations derived from the overlay alignment.

Table 2. Core Operational Elements in FS23/FS27 Hyperspectral Control Code

Component or Module	**Purpose**	**Key Methods or Actions**
Camera Initialization	Detects and opens the connection to the FS23 camera	`GetCameras()`, `OpenCamera()`, `InitCamera(...)`
Parameter Configuration	Sets acquisition parameters before scanning	`SetExposure()`, `SetFrameRate()`, `SetSpatialBinning()`, `SetSpectralBinning()`
Slit Homing or Alignment	Returns the scan slit to a known starting location (zero position)	`HomeSlit()` or `Homing()`
Scan Execution	Initiates line-scan (pushbroom) hyperspectral data acquisition	`StartGrab(samples)`
Frame Handling	Receives hyperspectral line frames and processes or buffers them	`GrabedData += OnGrabedData(...)`
Data Saving	Writes hyperspectral image data to `.spe` and generates ENVI-compatible `.hdr` file	Manual or buffered saving in BIL format
Scan Termination	Stops acquisition and finalizes file output	`StopGrab()`
Slit Position Tracking	Monitors or records the scan slit position during acquisition	Slit index calculation and optional write to file
Shutdown or Cleanup	Releases camera resources and closes the connection	`CloseCamera()`

To ensure measurement precision, the system was both optically and computationally calibrated. With 1920 pixels spanning a 3° horizontal field, the FS23 achieves approximately 0.09375 arcmin per pixel. In contrast, the Sony Alpha camera covers a 10° field across 1920 pixels, resulting in a scale of approximately 0.3125 arcmin per pixel. These angular mappings inform the scale and alignment of the overlay box used during real-time acquisition. This calibration framework allows for precise spatial-spectral registration, enabling downstream applications such as temporal object tracking, spectral anomaly detection, and material classification.

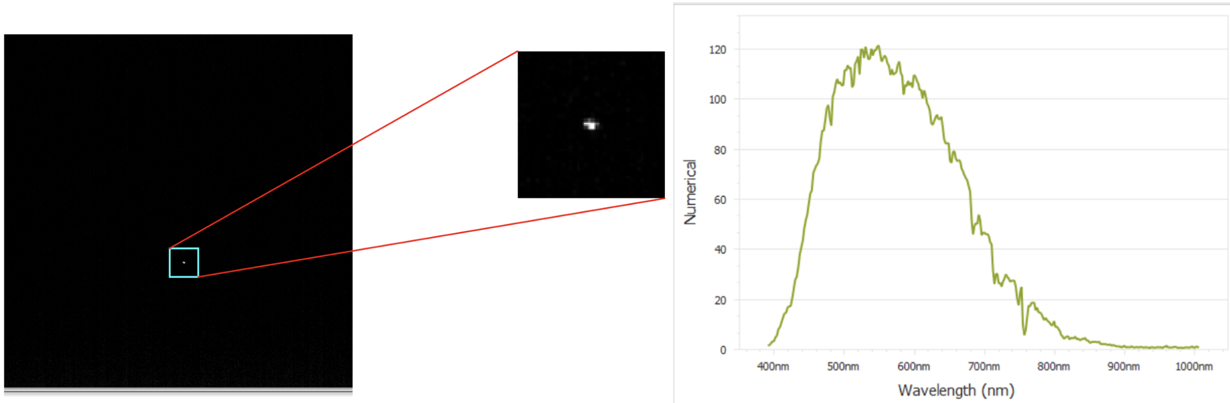

Figure 2: One-second exposure of Venus using the FS23 VNIR hyperspectral camera.

Using hyperspectral and multispectral imaging, each UAP detection is analyzed to determine its spectral signature. This includes identifying specific wavelengths emitted or reflected by the object, which may indicate material composition or active energy processes.

Expected Results

Expected Result	Details
1. *Creation of a Spectral Signature Library*	Development of a comprehensive database of spectral signatures for known objects, including satellites, aircraft, and natural phenomena. Objects will be categorized based on unique spectral profiles observed across VNIR and SWIR bands.
2. *Validation of Hyperspectral Cameras for UAP Research*	Demonstration of the ability of hyperspectral cameras to reliably capture and distinguish spectral signatures of known objects under varying environmental and observational conditions.
3. *Classification Accuracy*	High classification accuracy of known aerial objects (e.g., satellites, aircraft) based on their spectral characteristics. Algorithmic development will focus on distinguishing among objects with overlapping or ambiguous signatures.
4. *Detection of Anomalous Signatures*	Identification of spectral signatures that deviate significantly from known classes. Events meeting anomaly criteria will be flagged for further review and verification.
5. *Temporal and Spatial Tracking*	Use of sequential hyperspectral frames and time-synchronized video to derive object trajectories, velocities, and potential accelerative behavior.
6. *Multiband Correlation*	Correlation of data from VNIR, SWIR, and other spectral ranges to strengthen classification accuracy and anomaly detection through complementary features.
7. *Radiometric Calibration*	Regular calibration using blackbody standards or known reference targets to maintain accuracy in reflectance and emissivity measurements over time.
8. *Environmental Condition Testing*	Performance assessment of all sensors under diverse atmospheric conditions (e.g., diurnal cycles, humidity, cloud cover), followed by algorithmic adjustments to compensate for such variability.
9. *Integration with Other Sensors*	Synchronization and correlation of hyperspectral data with concurrent thermal (FLIR), high-speed visual, and RF sensor data to enhance identification confidence.
10. *Public or Scientific Dissemination*	Generation of visualizations, processed datasets, and summaries suitable for public outreach and peer-reviewed scientific publication.

Table 3. Expected Results of Hyperspectral UAP Imaging Study

Next Steps

Commissioning Phase: To prepare the system for operational deployment, the full sensor suite will first be installed on a portable, mount for commissioning. This mobile setup enables flexible field testing and debugging in varied environments. Controlled nighttime observations of known targets—such as commercial aircraft and satellites—will serve as the basis for evaluating instrument performance. These objects offer repeatable, trackable signatures ideal for verifying spatial alignment, spectral calibration, and synchronization across the VNIR and SWIR hyperspectral cameras, thermal sensors, and high-speed imaging systems. This iterative testing process is essential for diagnosing and resolving software or hardware issues prior to full integration on the main observatory platform.

Figure 3: Angstrom Instrumentation package on a portable field tripod

Operational Data Collection: Following commissioning, the sensor package will be mounted on a rigid, co-aligned optical cage integrated with a 0.5-meter PlaneWave telescope. The cage will support the VNIR and SWIR hyperspectral imagers, radiometric thermal sensors, a high-sensitivity visible/NIR camera, a 40× optical zoom Beacon 8.0 PTZ system, and the Phantom v890 high-speed camera. Deployment will take place at a remote field station in southwest New Mexico, selected for its high elevation, low atmospheric turbidity, and minimal light pollution. To minimize false positives, the site will implement ADS-B and satellite ephemeris filtering to exclude known aerial and orbital traffic.

Upon detection of an anomalous object, the telescope will autonomously slew to its coordinates. Once the target is centered within the shared field of view, all imaging systems will initiate synchronized data acquisition. The Beacon 8.0 PTZ camera will provide long-range context and active tracking, while the Phantom system will capture flight path morphology and dynamic motion characteristics such as acceleration and abrupt maneuvers. These kinetic data, combined with high-resolution spectral and radiometric imagery, will produce a multidimensional observational dataset for rigorous scientific analysis of UAP.

Figure 4: SW New Mexico Polaris Observatory- 0.5 meter Planewave telescope and L500 mount. To the right is the Beacon 8.0 PTZ for wide field acquisition

Machine Learning Integration: As the volume of captured data grows, machine learning algorithms will be introduced to enhance system performance. These models will be trained on verified observations to improve real-time anomaly detection and classification, increasing the reliability and scalability of the detection pipeline across diverse operational conditions.

Implications for Aerospace Safety

Creating a validated spectral library for known aerial objects enhances aerospace safety. It enables real-time anomaly detection and classification of unidentified or unauthorized objects. By enabling real-time classification and anomaly detection through hyperspectral imaging, operators can more reliably distinguish between conventional aircraft, satellites, and unidentified or unauthorized objects.

Moreover, the integration of hyperspectral data with existing sensor systems—such as radar, FLIR, and RF—provides a more comprehensive situational awareness framework. This multisensor fusion supports early warning systems, airspace deconfliction, and improved post-incident analysis.

Ultimately, these capabilities contribute to more robust aerospace traffic management, reduce the risk of mid-air incidents, and enhance the ability of defense and civilian systems to identify and respond to aerial threats in a timely and informed manner.

Summary

This study leverages hyperspectral imaging to establish a spectral signature library of known aerial objects—including satellites and aircraft—using advanced VNIR and SWIR pushbroom cameras. By capturing and classifying the unique spectral profiles of these targets, the research aims to create a robust reference dataset for comparison against unknowns, including Unidentified Aerial Phenomena (UAPs).

Hyperspectral cameras provide pixel-level spectral detail, enabling the identification of subtle material signatures and anomalous features undetectable by conventional imaging systems. The integration of spectral, spatial, and behavioral data is expected to improve object classification accuracy, reduce false positives, and refine detection methods.

Additionally, this work supports the development of advanced analytical tools and machine learning algorithms for real-time anomaly classification. The methods presented lay a foundation for reliable UAP analysis and support future advances in multisensor object characterization.

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