We know what's at stake.

Space Domain Awareness of Resident Space Objects Bearing Cyber-Suspicious Indicators

Data Mine of the Rockies | American Systems

Kinzy Pearson | Junior Systems Engineer

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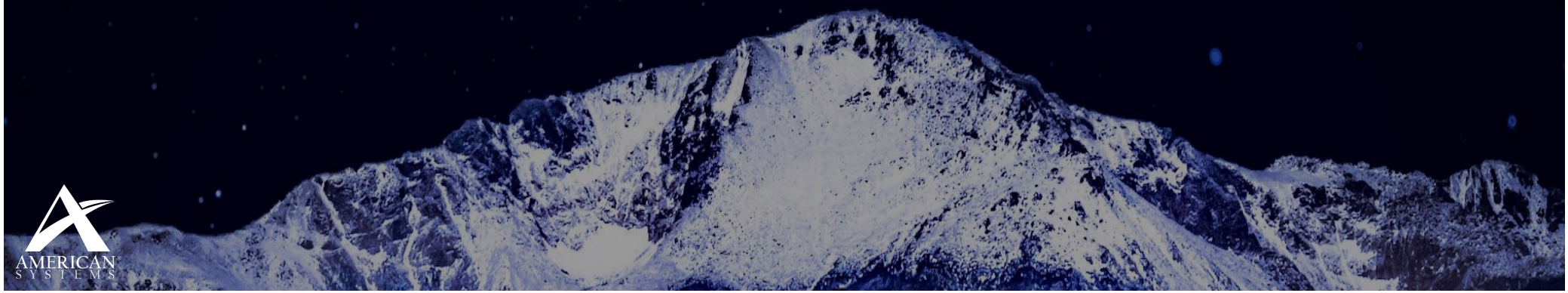
Agenda

- Case Studies
- Research Transition
- Abstracts A – C
- Implementation & Timeline
- Future Work & Impact



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Data Mine of the Rockies – Purdue University

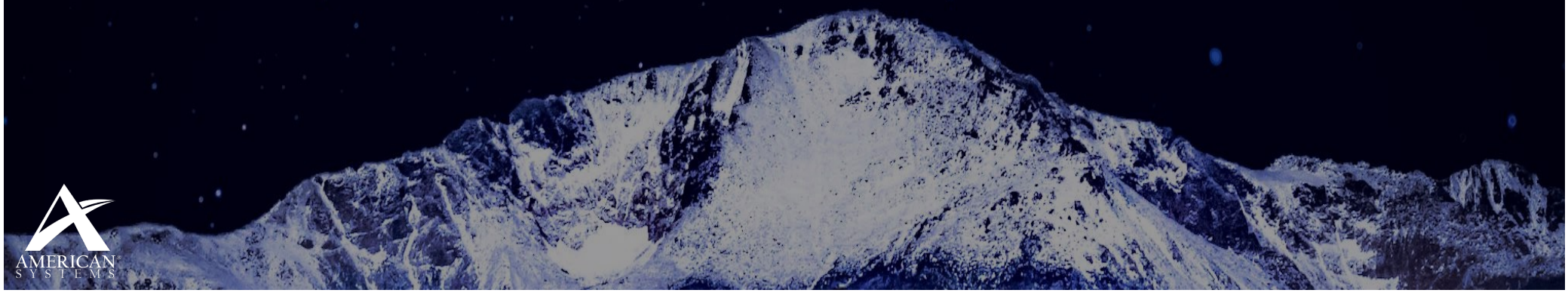
Case Studies

Cosmos 2499:
Misclassified satellite performed rendezvous proximity operations on U.S. asset

Shiyan 7:
Robotic arm demonstration, dual use technology risks

ViaSat attack:
Cyber exploitation of space assets

These cases highlight the need for proactive space domain awareness and detection frameworks



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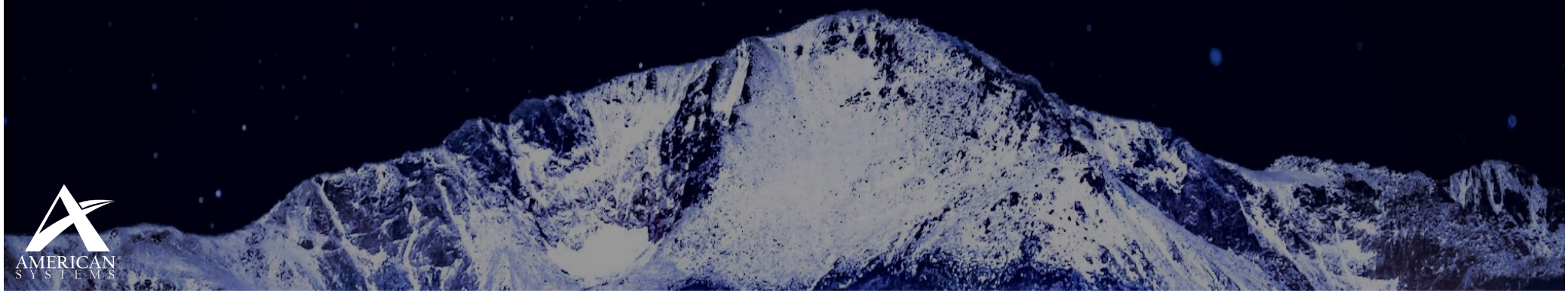
Research Transition

Original Focus:
Research on how debris and cyber intersected in LEO

Key Findings:
Space objects can be misclassified, concealing mission intent and anomalous behavior

Gap Identified:
SDA TAP Lab problem statements highlighted absence of standardized framework for cyber-suspicious RSOs

DMR Pivot:
Research formalized into 3 main abstracts, expanding and addressing the gap with detection, classification, and operator tools



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Abstract A – Detection & Attribution

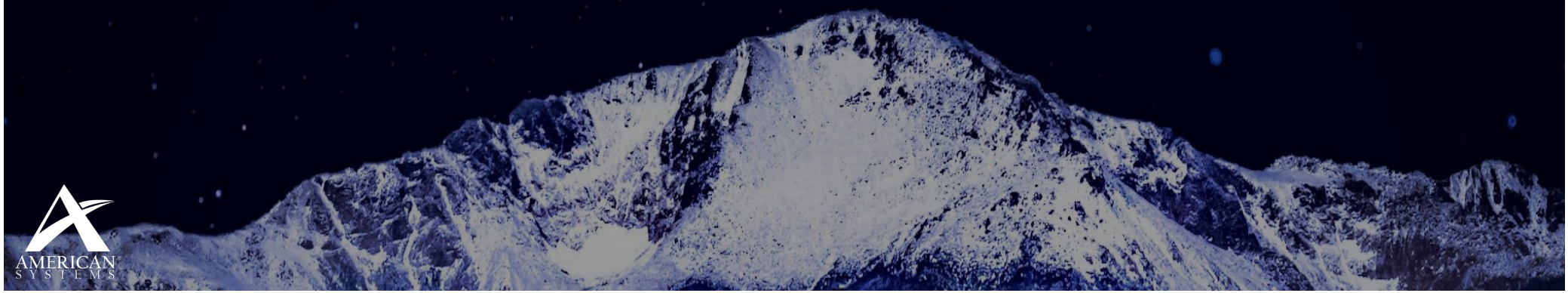
Identify orbital behaviors in GEO inconsistent with cataloged or declared functions

Calibrate the program by comparing predicted vs observed trajectories using TLEs

Evaluate deviations in stability, maneuvers, and spatial patterns

Distinguish benign anomalies from deliberate deception

SDA TAP Lab Problem Statements: 15, 17, 18, & 47



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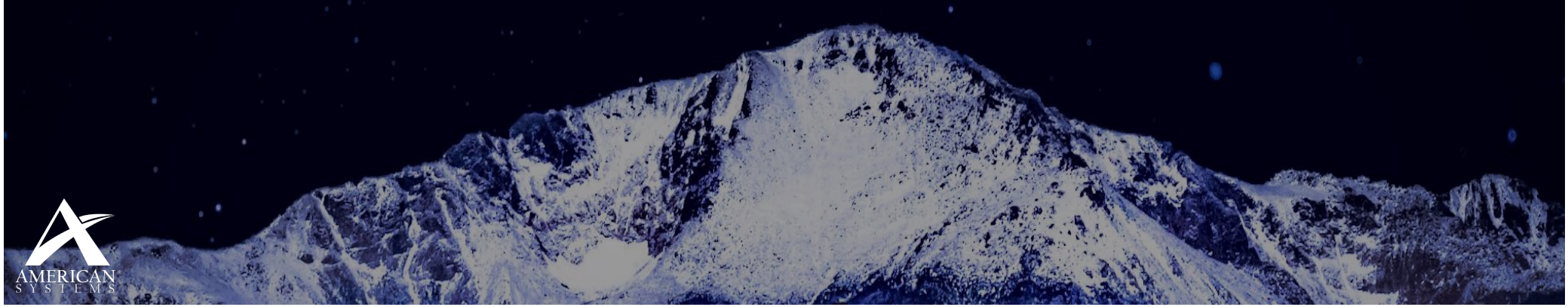
Abstract A – Technical Approaches

Data:
TLE catalogs, trajectory simulations, & orbital stability metrics

Methods:
Statistical anomaly detection & simulation modeling

Tools:
Python, STK, & MATLAB

Outputs:
Baseline framework for detecting deceptive orbital behavior



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Abstract B – Behavioral Classification

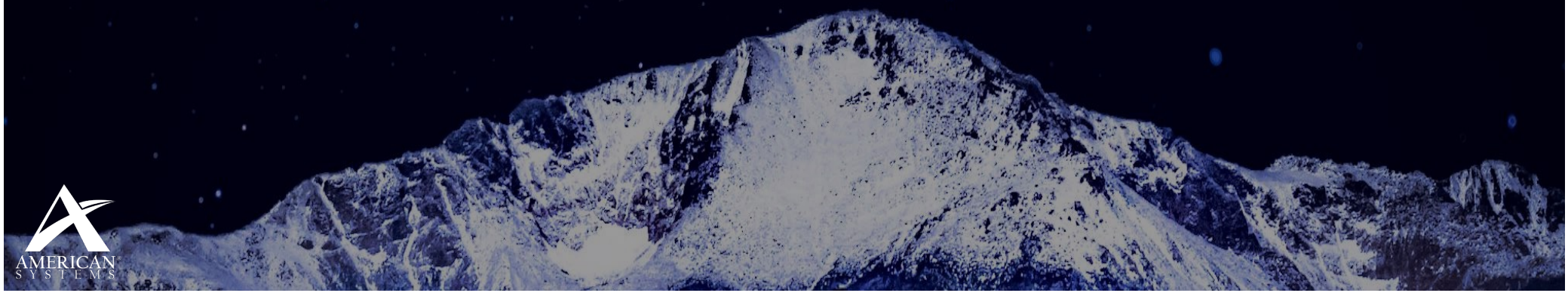
Use Multi-Domain Indicators: Photometry, radio frequency, radar cross-section, & maneuver history

Build "pattern-of-life" baselines for RSO activity

Assign behavior labels (stable, maneuvering, anomalous, & uncooperative)

Flag deviations from baseline for escalation

SDA TAP Lab Problem Statements: 19, 20, 21, & 22



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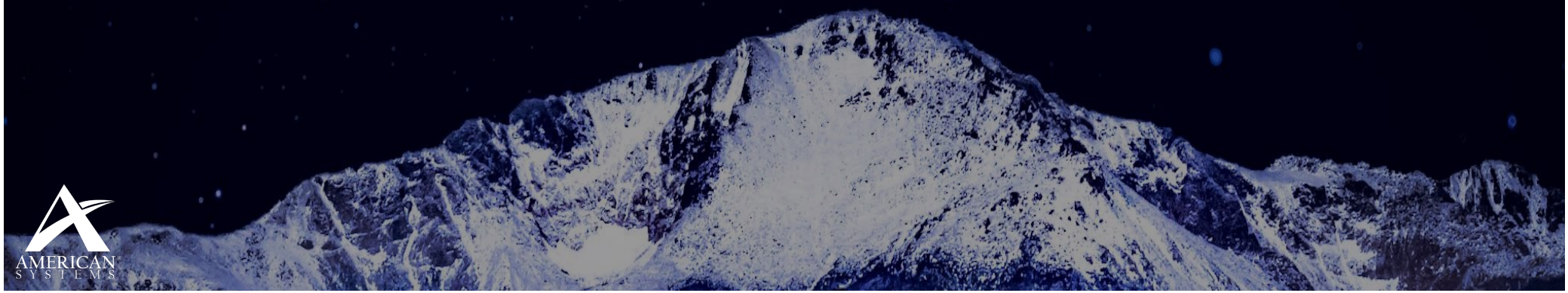
Abstract B – Technical Approaches

Data:
Multimodal (Photometry, RF, RCS, & maneuver history)

Methods:
Pattern recognition & machine learning classifiers

Tools:
Python & AI/ML pipelines

Outputs:
Cross-domain classification framework with behavioral tags



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Abstract C – Threat Scoring & Operator Interface

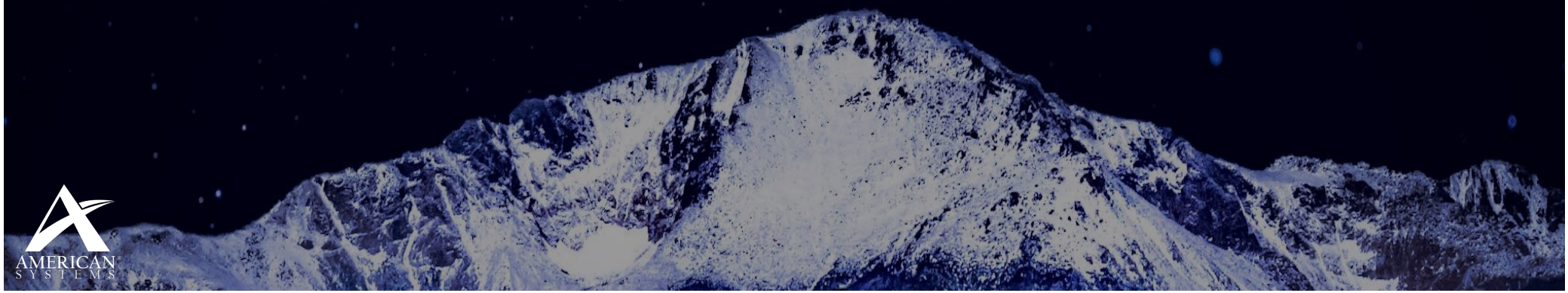
Develop quantitative risk scoring system from multiple indicators

Provide visualize outputs in operator-facing UI

Ensure automation is transparent and analyst-driven

Integrate detection/classification into actionable SDA intelligence

SDA TAP Lab Problem Statements: 47, 52, & 53



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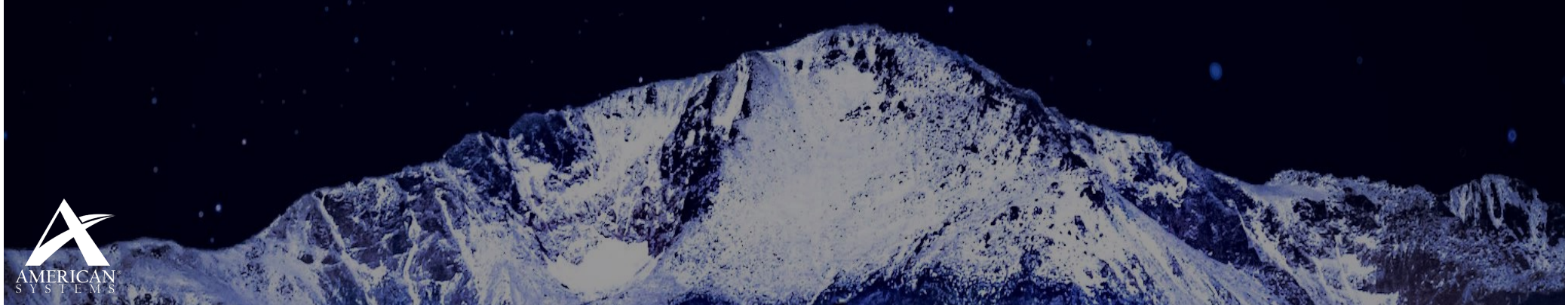
Abstract C – Technical Approaches

Data:
Integrated outputs from Abstracts A & B

Methods:
Scoring logic, confidence levels, & traceable workflows

Tools:
PowerBI & prototype UI frameworks

Outputs:
Operator interface with scoring engine & decision support



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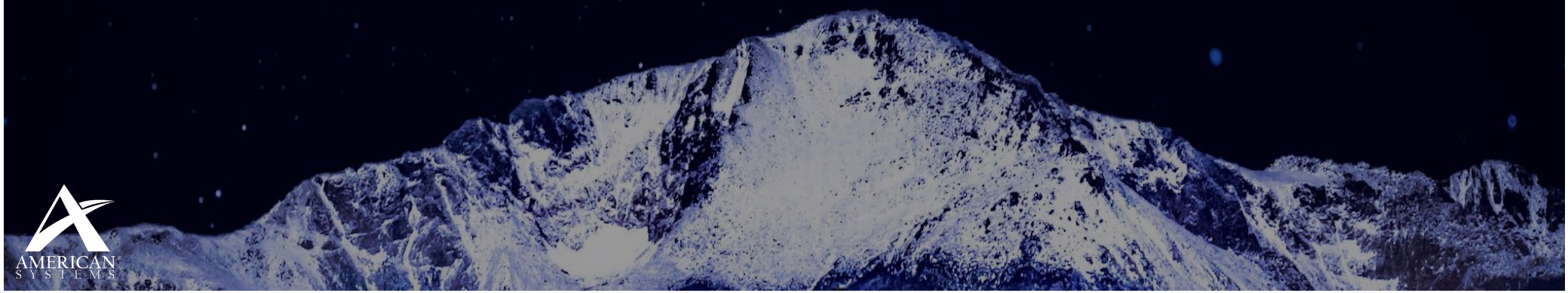
Implementation Plan & Timeline

Fall 2025:
Familiarization, tool identification, & prototype concepts

Dec 2025:
First-semester findings & baseline framework presented

Spring 2026:
Refined prototypes & develop operator-facing UI/UX

Long-Term (Future Work):
Modular, multi-semester growth into an SDA capability



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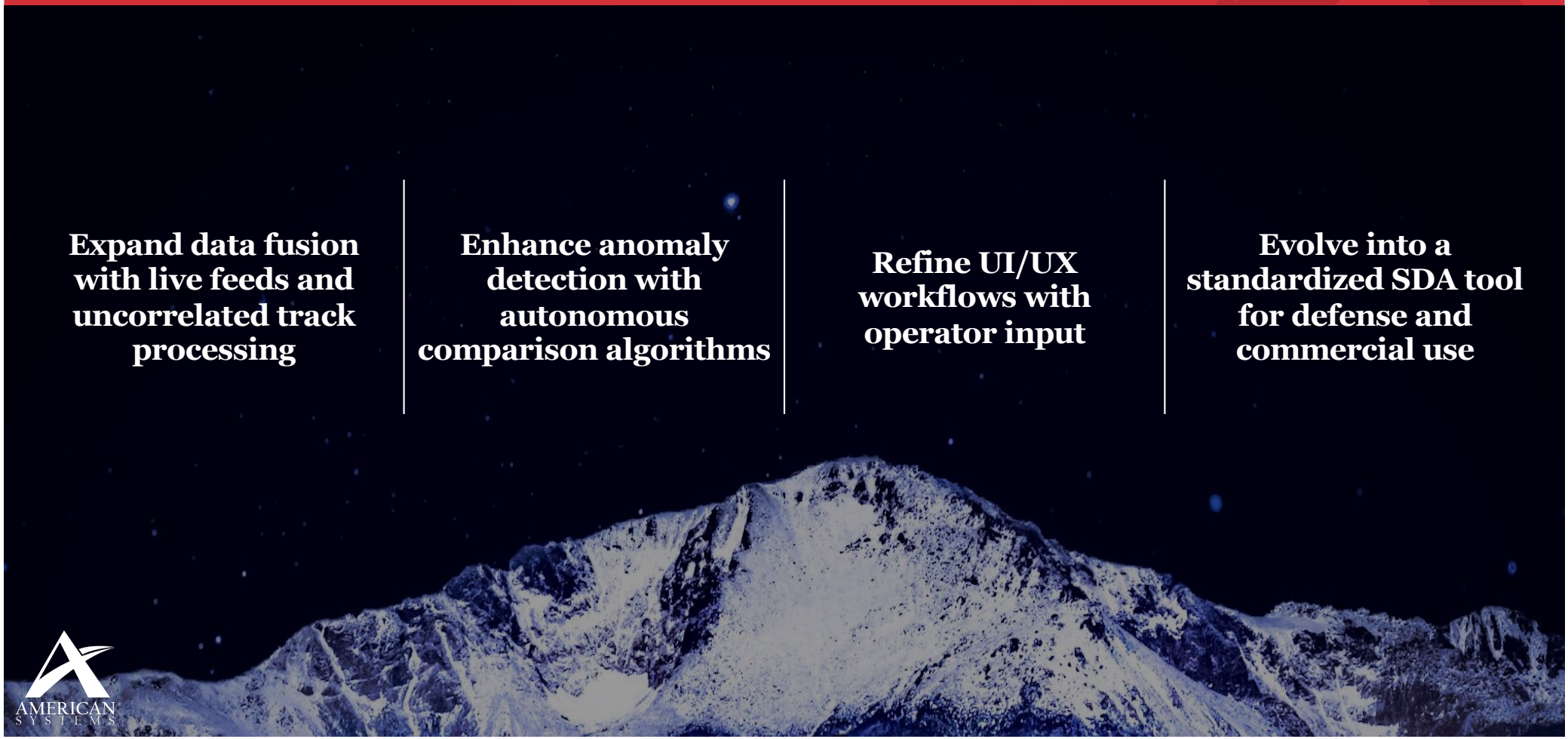
Future Work



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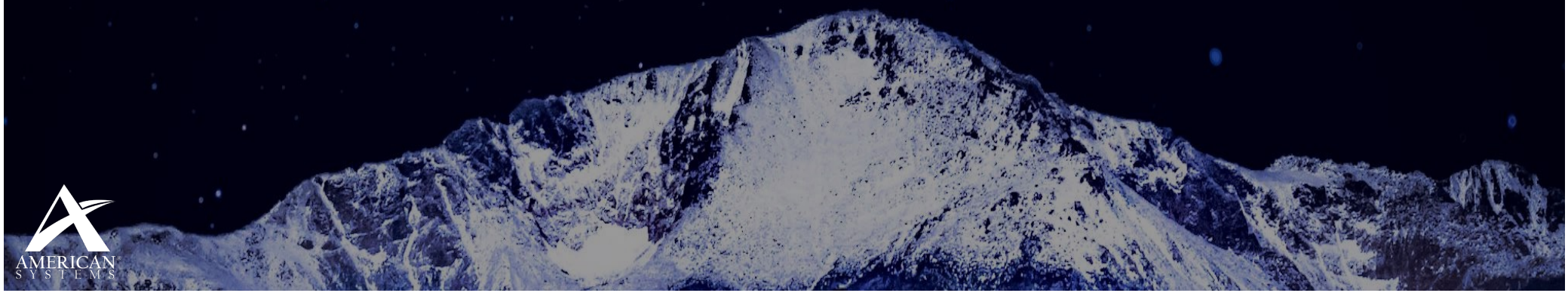
Expected Impact

Operational:
Improve anomaly detection for faster escalation of decisions

Academic:
Pioneering SDA classification frameworks for future cohorts

National Security:
Enhances resilience against adversary deception in orbit

Commercial Security:
Protects commercial assets critical to U.S. leadership as a spacefaring nation



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Questions?

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