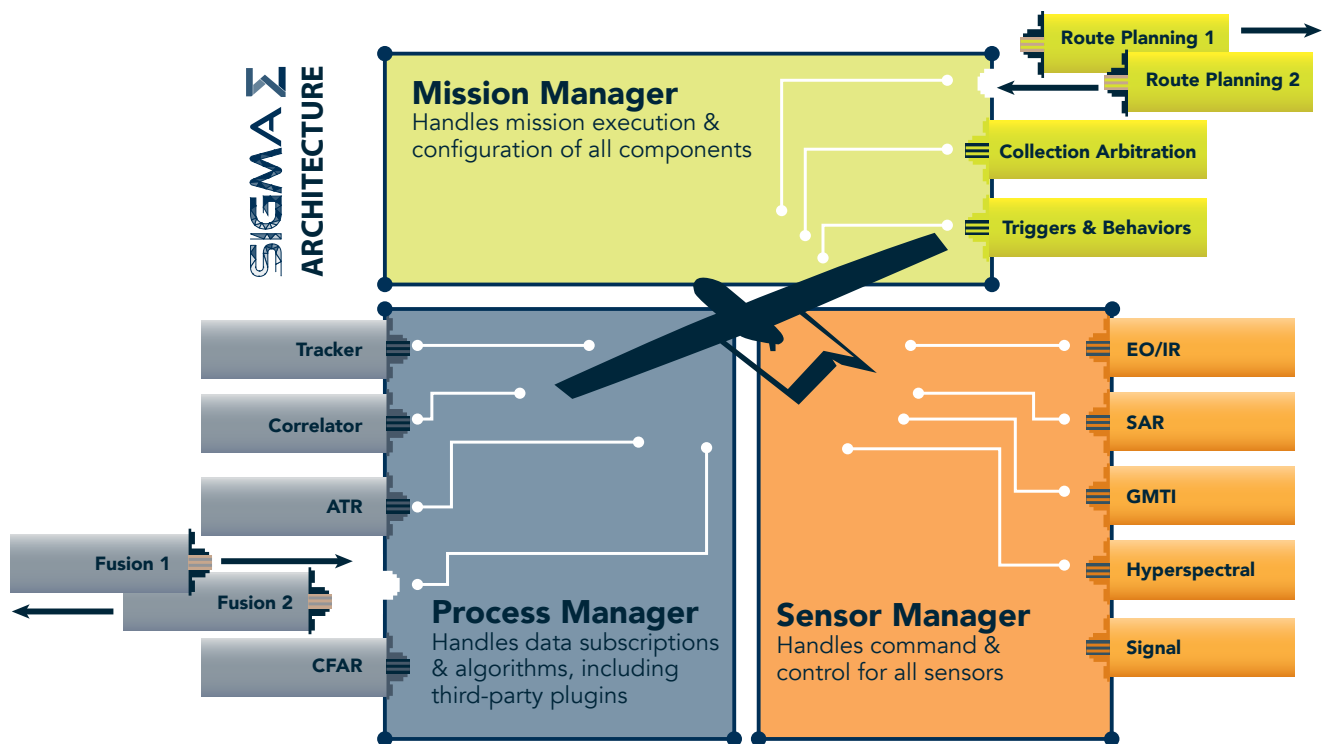# SIGMA

## ISR Mission Autonomy

The Space Dynamics Laboratory and the Naval Research Laboratory have developed an open architecture software product, SIGMA (Systems Intelligence Manager), to enable one or many manned or unmanned platforms to accomplish an intelligence, surveillance, and reconnaissance (ISR) mission collaboratively and autonomously. Coordinating sensor command and control, data collection, and data processing, the embedded SIGMA software architecture can adapt to dynamic missions across the DoD enterprise.
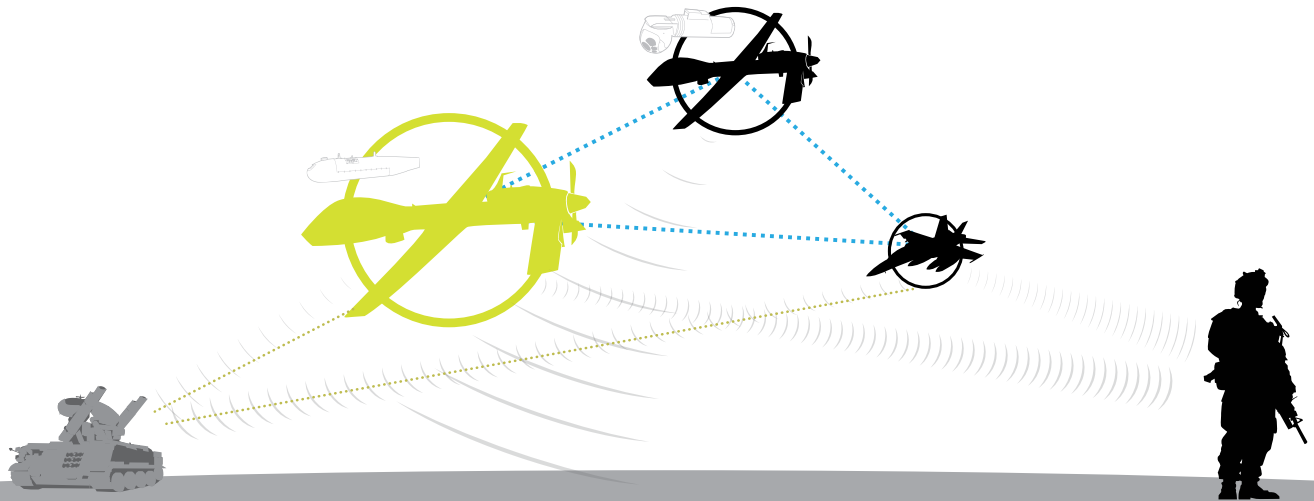
SIGMA reduces the need for 1-to-1 slaving of sensor to operator, boosts the value of ISR data streams by increasing detection probability, maximizes asset tasking while minimizing necessary user interaction, enables adaptive autonomous missions, turns generic sensors into modular assets, and enables networking of in-situ sensors for meshed situational awareness.

SIGMA has proven flight heritage under several DoD programs and has demonstrated multifaceted autonomous cross-cueing (e.g., SAR, GMTI, EO/IR, WAMI, FMV) from multiple airborne platforms.

## FEATURES

- Embedded swarming software framework
- Plug-in API for advanced correlation, data mining & fusion operations
- Task arbitration across entire swarm
- Control, correlation & ingest of multi-INT sensor data for rapid exploitation & actionable ISR
- Reliable data transmission over unreliable data links
- Autonomous mission coordination
- Command, control (C2) & data processing for multiple sensors
- High-fidelity Position, Navigation & Timing (PNT) distribution
- Government purpose rights



SIGMA Σ ARCHITECTURE

**Mission Manager**
Handles mission execution & configuration of all components

Route Planning 1
Route Planning 2
Collection Arbitration
Triggers & Behaviors

Tracker
Correlator
ATR
Fusion 1
Fusion 2
CFAR

**Process Manager**
Handles data subscriptions & algorithms, including third-party plugins

**Sensor Manager**
Handles command & control for all sensors

EO/IR
SAR
GMTI
Hyperspectral
Signal

**SIGMA USES EXISTING SENSOR ASSETS TO CREATE AUTONOMOUS CROSS-CUEING NETWORKS**
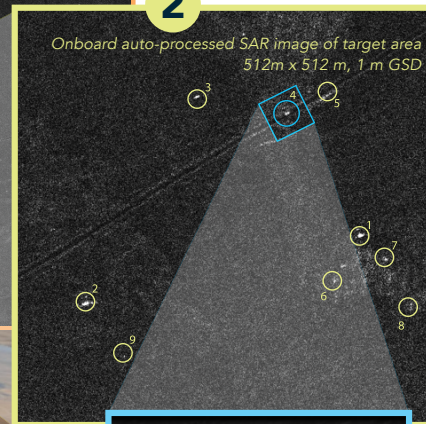
## AIRBORNE SAR CUEING EO/IR

Illustrates how SIGMA performs SAR to EO/IR cross-cueing in real time
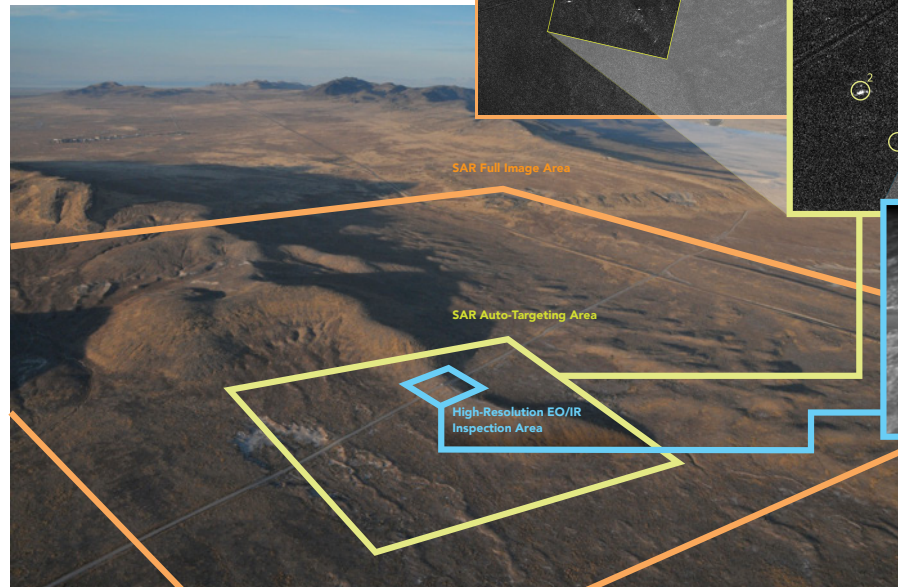
**1** Fly surveillance collection flight pass: SAR, hyperspectral, wide-area EO

Autogenerate SAR sub-image in flight (via full backprojection)

Perform automated target detection & analysis on SAR, HSI & wide-area EO images

Promote target detections to image inspection requests (cues)

**2** *Onboard auto-processed SAR image of target area 512m x 512 m, 1 m GSD*

### 9 POTENTIAL TARGETS DETECTED

- By auto-target detection algorithm
- All tasks performed on embedded hardware

(Cue results ordered by strength of target detection)

1. Large corner reflector
2. Large corner reflector
3. Medium corner reflector
4. SUV
5. Roadside berm
6. ~2' metal cube
7. Metal water tank
8. Terrain
9. Terrain

*Auto-imaged high-resolution EO/IR inspection of cue "4"*

SAR Full Image Area

SAR Auto-Targeting Area

High-Resolution EO/IR Inspection Area

**3** Subsequently, high-resolution EO/IR auto-collects inspection images for all cued targets

**U.S. NAVAL RESEARCH LABORATORY**

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