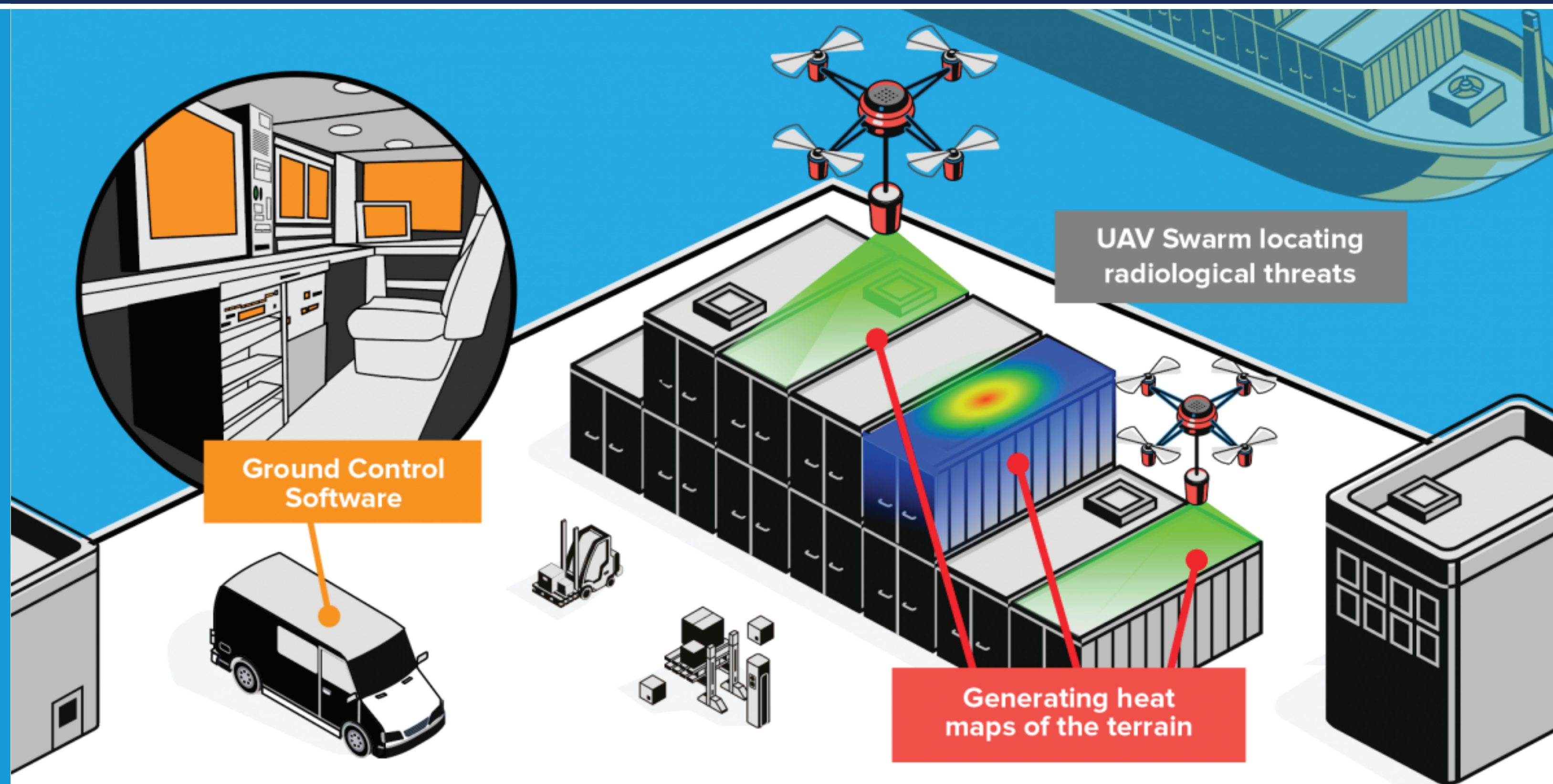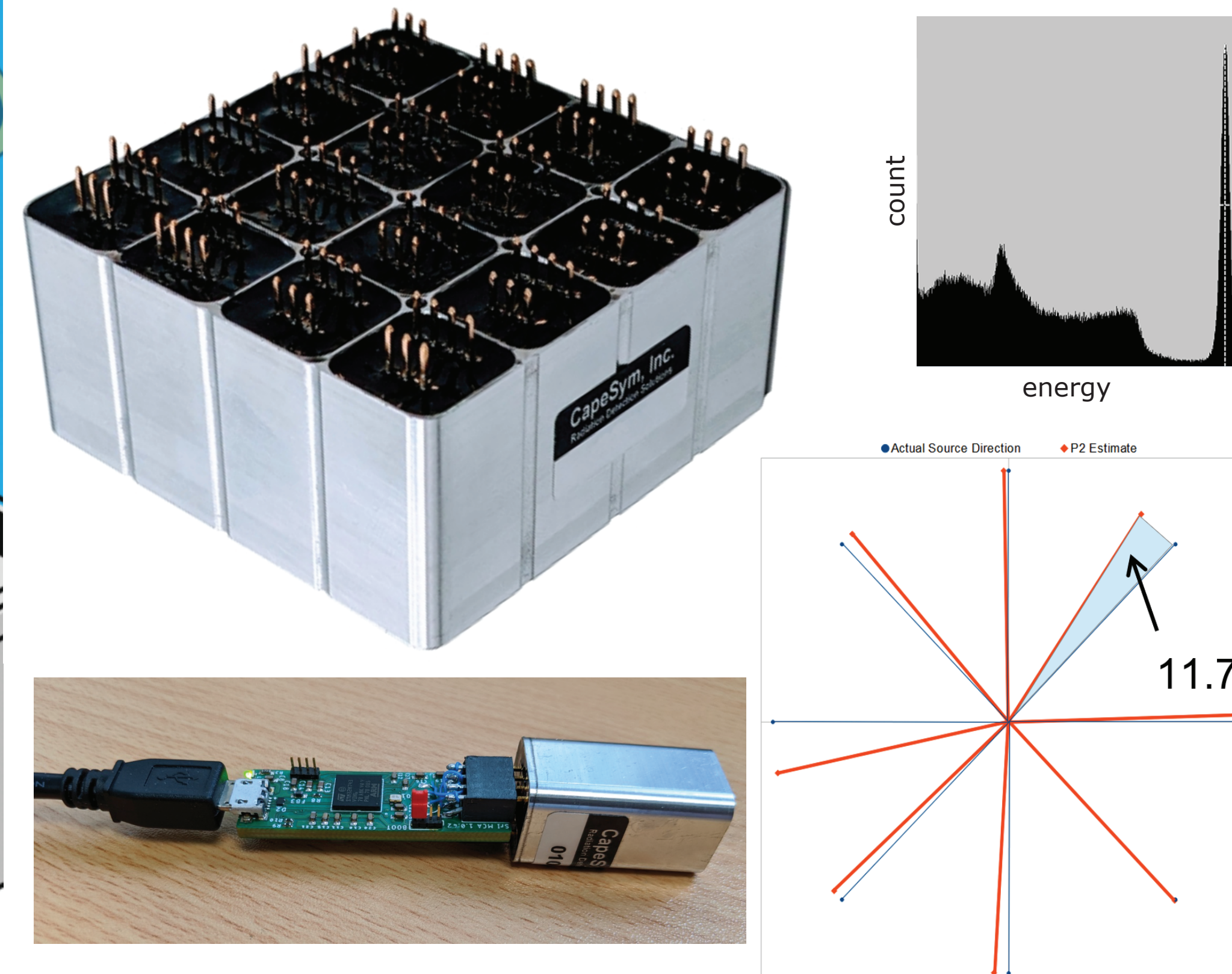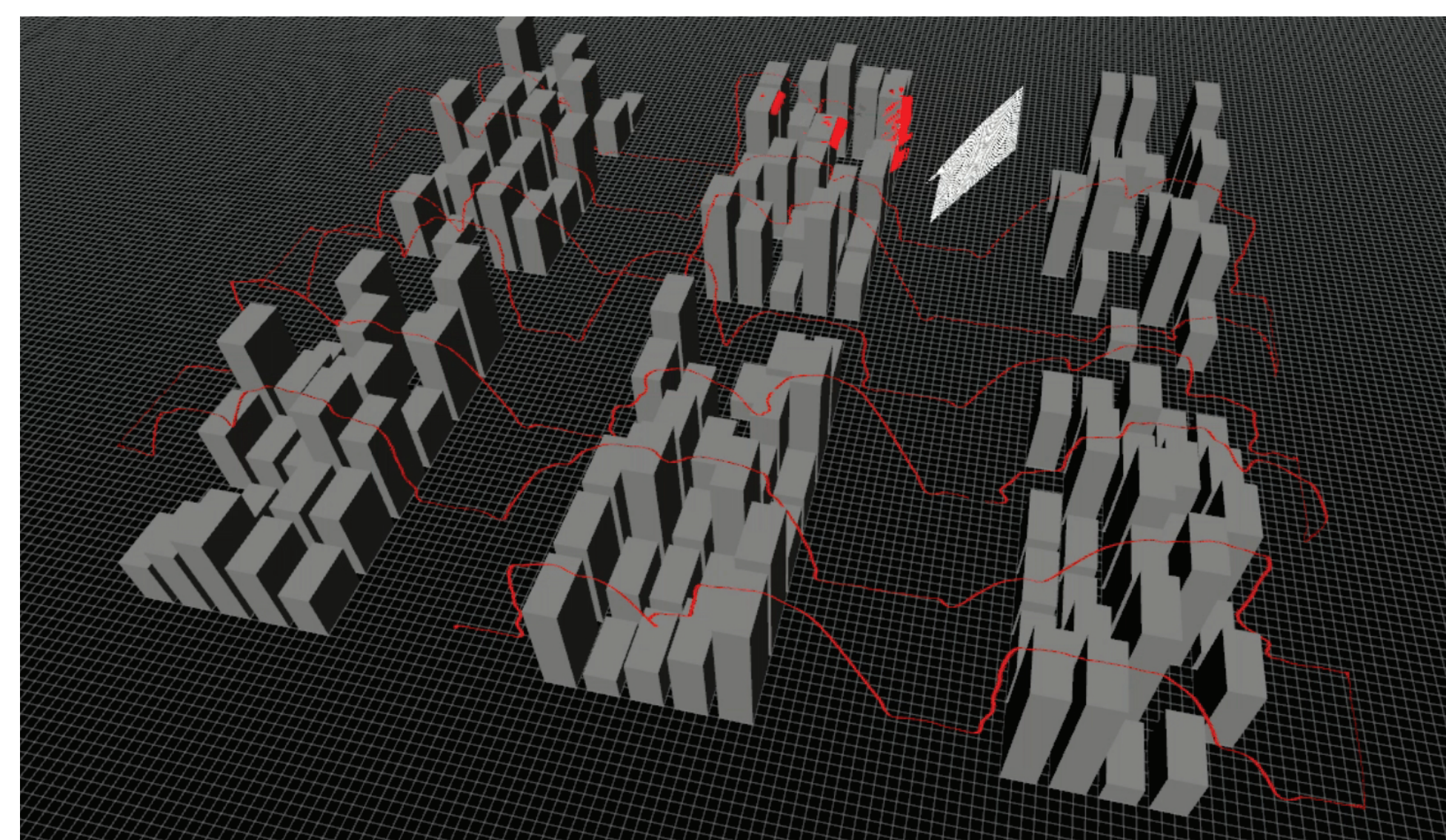# Autonomous drones with directional sensors to locate radioactive sources in complex environments

Perry Franklin, Daniel Stouch, Matt Kwan, Rich Wronski, Shariar Motakef, John Fiala, Ivan Khodyuk

UAV Swarm locating radiological threats

Ground Control Software

Generating heat maps of the terrain

Modeling and simulation help develop and refine autonomous capabilities to explore complex environments

Approach

Enable specialists to conduct surveys for anomalous radiological threats using autonomous uncrewed aerial vehicles (UAVs)
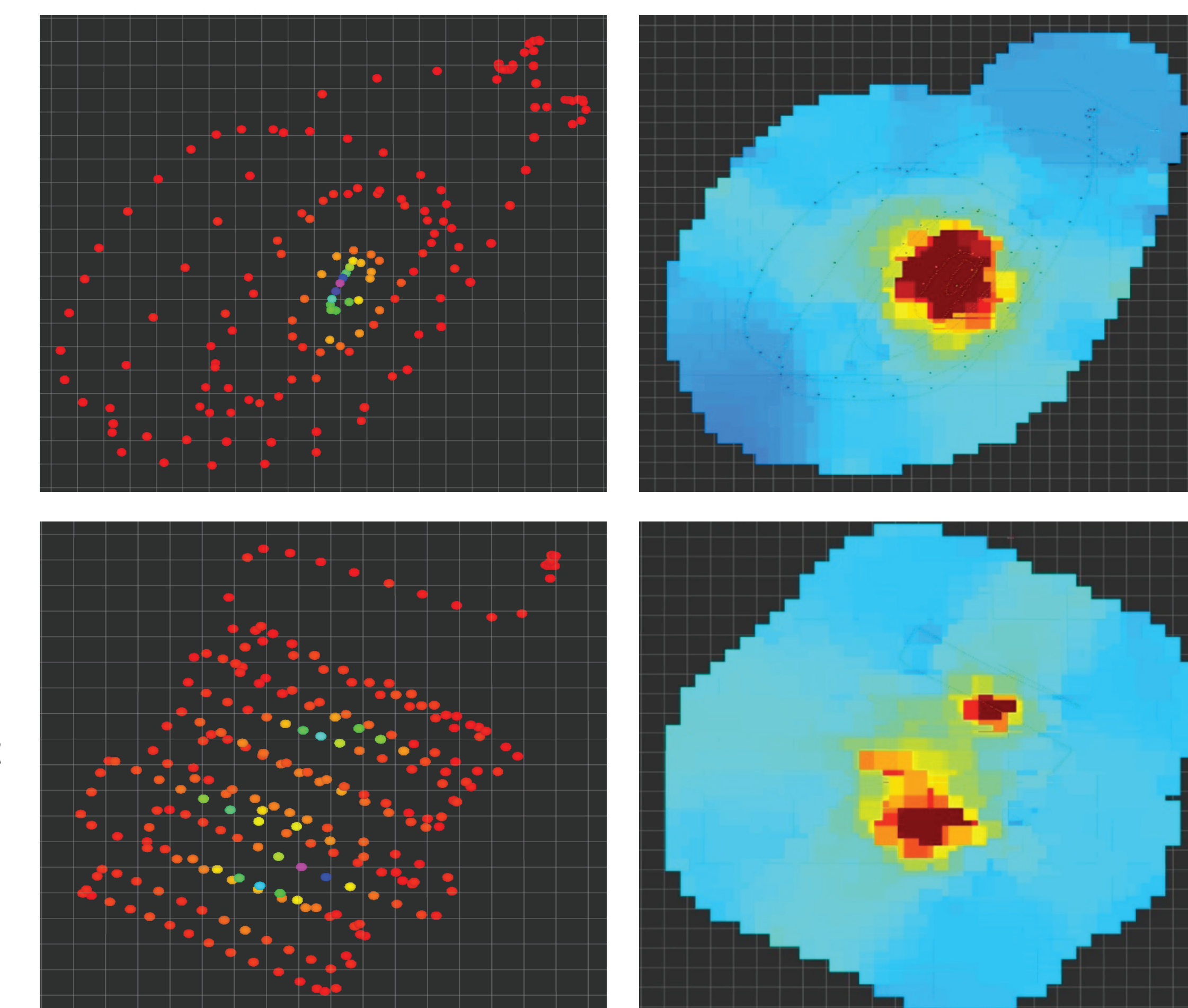
Incorporate state-of-the-art visual perception, mapping, and optimal path planning techniques and perform terrain following at a specified standoff distance enabling the rapid search for radiological threats

Provide directional detection information to a 3D environment model, assisted by a novel radiation crystal configurations

Avoid collisions while exploring challenging and dynamic unknown environments by fusing this directional information with localization and adaptive local path planning capabilities to ensure full search area coverage

count / energy

11.7°

Custom directional 16 module radiation sensor increases detection sensitivity and enables rapid source localization

Nvidia Jetson TX2 low-power embedded computing platform

Tattu Plus 22000 mah 25C LiPo battery

Jeti DS-13 Radio Control Transmitter

Intel RealSense D-435 3D camera

Inspired Flight IF-1200 uncrewed aerial vehicle (UAV)

Gremsy S1V3 gimbal camera mount

MicroHard pMDDL2550-ENC wireless 2.5GHz digital data link

VOXL PX4 flight controller

Integrated off the shelf components enable low cost, reliable autonomous capabilities

Benefits

- Onboard autonomy enables obstacle avoidance
- Dynamic path planning enables faster area searches
- Directional sensing quickly localizes sources
- 3D object mapping provides precise source localization
- Onboard sensor fusion allows heatmap overlays
- Object detection helps determine response priorities
- Multi-UAV coordination reduces search times
- Autonomy reduces operating cost per survey mission
- Capability significantly reduces exposure risk
- Autonomy reduces specialized training requirements

Radiation heatmaps generated in real time using a spiral search for one source (top) and a raster pattern for two sources (bottom)
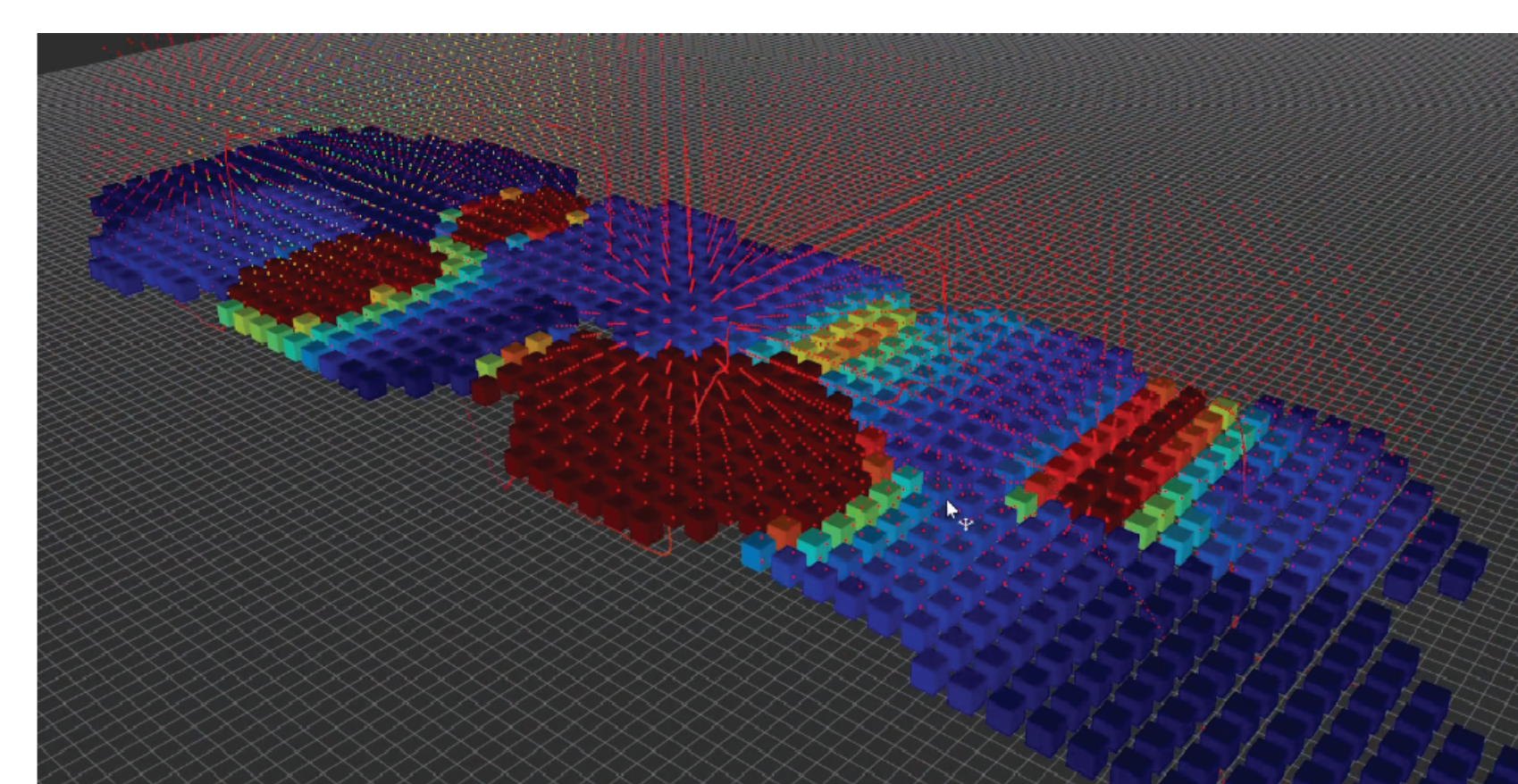
Real-time 3D heatmap renderings provide geospatial context for response

Contacts

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