Mapping (Nuclear) Radiation from Aerial Platforms in 3D

A.k.a. Making Nuclear Radiation Visible in 3-D (in “color” & real-time)

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Mapping from Aerial Platforms
“Gamma-Ray Eyes in the Sky”

- Multi-sensor package
- Mini-UAV in flight
- Visual Camera
- Batteries
- Cooling system
- Computer + GPS + IMU
- HEMI Compton Camera

ARES program

- Point source measurement
- Full 3D Contamination mapping in Fukushima

- Full 3D surface reconstruction & intensity projection in Pacifica, CA

Berkeley Applied Nuclear Physics Program
Detection and mapping of radiological materials from small unmanned aerial systems (UAS) or drones – Enormous advances in autonomous systems provide unparalleled capabilities for in-accessible or hazardous areas.

- Radioactive source detected, identified, and localized.
- Processing and display in near-real time!
- Data reconstruction done on the platform, only data products are transferred.

Building at RFS

Radioactive source detected, identified, and localized.
Power of Scene Data Fusion on larger aerial platforms

- From remote-controlled RMAX to manned Bell helicopter

- Reconstructed 3D surface and flight path
- Flight path and scene reconstructed from visual images
- 1.5 mCi Cs-137
- Etcheverry Hall UC Berkeley
- 3D fused radiation map (from single fly-over)
- <30 min for measurement and reconstruction!
- Accurate radiation maps (~m resolution) with “cold” road and river
- No “hot spots” as seen by conventional means
Mapping from Aerial Platforms
“Gamma-Ray Eyes in the Sky”

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- Processing and display in near-real time!
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13 min UAS flight measurement
3 story building made of thick concrete
Hidden source in 3rd floor corner room
Mapping of Distributed (Two) Sources @ INL

- Two blast locations with 0.7 Ci and 0.3 Ci Br-82 ($T_{1/2} \sim 3$ hrs)

- Real-time and on-board, 3D scene mapping and data fusion!
Mapping of Distributed (Two) Sources @ INL

- Two blast locations with 0.7 Ci and 0.3 Ci Br-82 ($T_{1/2} \sim 3$ hrs)

  Location: Idaho National Lab  
  Measurement area: $\sim 10,000 \text{ m}^2$  
  Measurement time: < 10 minutes

- Significantly enhanced speed and accuracy in detecting and reconstructing both distributions (in 3D)!
Radiological Contamination Mapping in Fukushima Scene-Data Fusion: “Seeing Gamma Radiation in 3-D”

- Complete map of complex 3D environments within minutes
- ~80 m
- <15 min for measurement and reconstruction!

- Future: Map contamination in 3D providing emission rates and dose-rates anywhere, with fully automated tracking
Radiation Mapping at Chernobyl
The “Claw”
Enormous advances in sensing, data processing, computer vision, and autonomous systems provide unprecedented capabilities in detecting and mapping radiological and nuclear materials in 3D from aerial platforms;

At the core of our research is the fusion and reconstruction of scene & contextual data with radiological detection and imaging data providing the ability to visualize radiation in 3-D and in real time.

These data processing and 3-D data fusion concepts could be applied to other quantities and signatures, such as hyperspectral (e.g. vis and IR), radar, etc.
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