EPA's Integrated Rad Remediation Decision Support Tool (IRRD-ST) to Optimize Radiological Cleanup Decisions

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TOPICS

- Background/Drivers
- Project Overview
- Primary Objectives
- Methodology Overview
- Field Study
- Tool Enhancement
- Next Steps

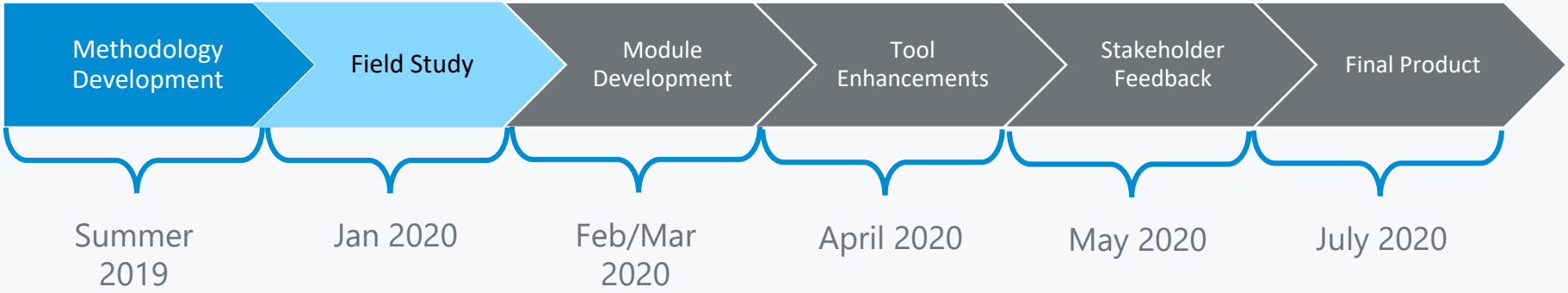
BACKGROUND/DRIVERS

- EPA performs radiation field surveys in support of
  - Contamination assessments for industrial process decommissioning
  - Site remediation
  - National security response teams to characterize, restrict, reclaim areas damaged by intentional dispersion
- Variety of modern detection technologies presents opportunities …
  - Accuracy, resolution, remote deployment, multichannel sensors

  and challenges …
  - Data volume, range of operator experience, interface, integration
- Integrated Rad Remediation Decision Support Tool (IRRD-ST) is needed to address data management challenges, exploit technology advances, and achieve an efficient workflow

BACKGROUND/DRIVERS: EXAMPLE

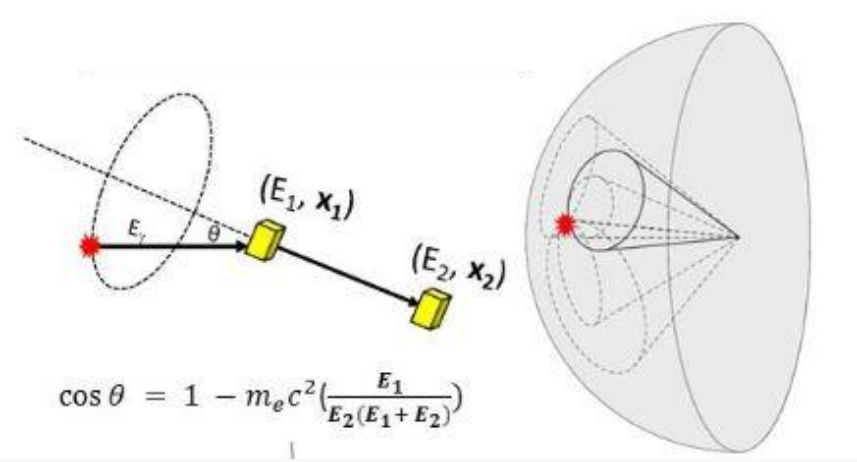
PROJECT OVERVIEW



- Methodology Development
  - Develop approach to combine semi-automated image processing with radiation physics
  - Streamline processing of 2-D composite gamma-optical imagery
  - Establish optimal field conditions
- Field Study
  - Image collection
  - Controlled sources
  - Typical industrial setting
- Module Development
  - Program features to process imagery and extract contamination area estimates
- Tool Enhancements
  - Integrate module into the IRRD-ST for estimating decontamination costs
- Stakeholder Feedback
- Final Product
  - Enhanced MS Excel-based Tool

IRRD-ST INCREMENTAL DEVELOPMENT TASK

- Import/ingest composite gamma-optical 2D images
- Facilitate accurate spatial contamination area calculations
- Compton-imaging detectors based on CZT or GeGI provide spatial gamma-ray "camera"



Graphic from PHDS Co website

METHODOLOGY OVERVIEW

1. Identify camera position, orientation, optical properties
2. Establish image surroundings using semi-automated CAD
3. Extract contamination contours
4. Project contamination contours onto 3-D surfaces
5. Apply radiation transport corrections
6. Calculate orthogonal area as a function of intensity
7. Package in a simple GUI add-in for XLS tool

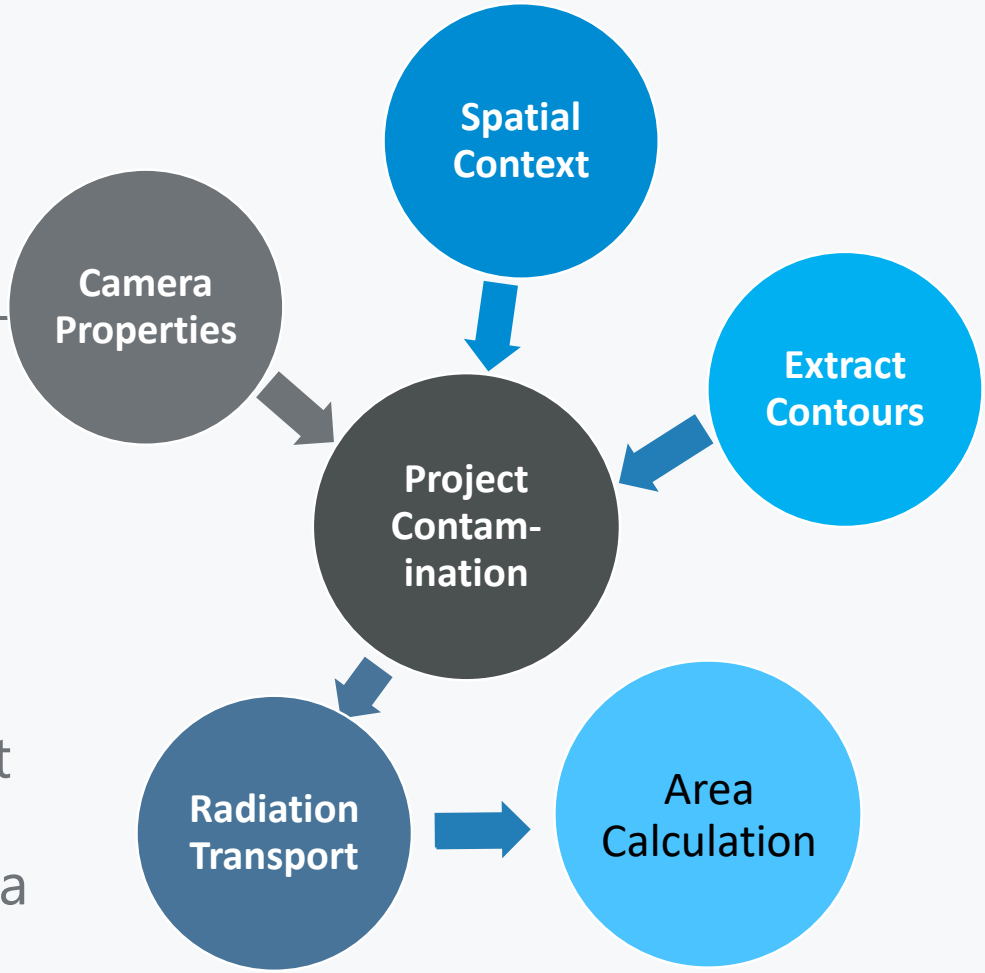
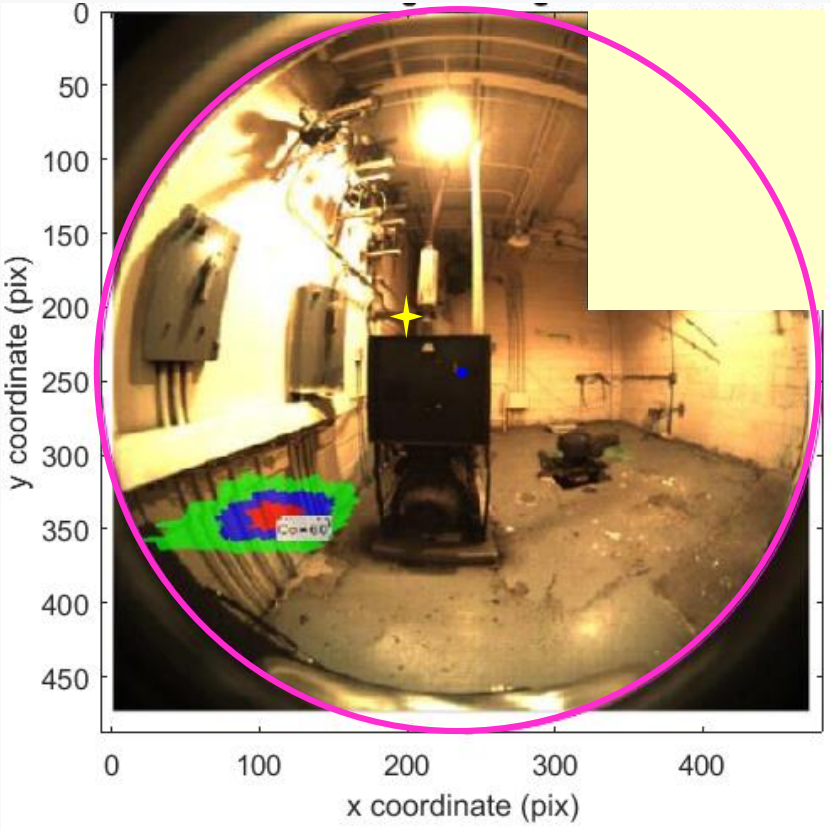


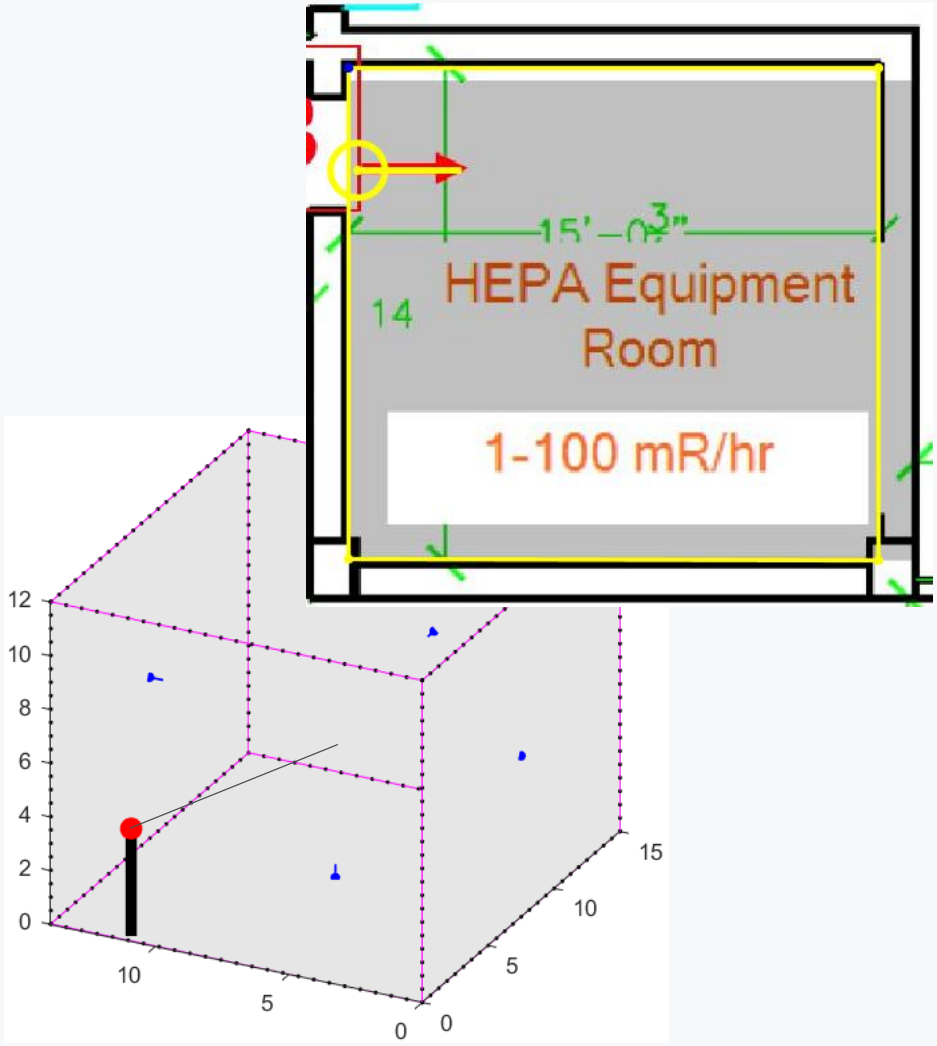
IMAGE CENTER AND MAXIMUM FIELD OF VIEW

- Image center aligns with camera view direction
- Max field of view defines spatial range
- Camera lens function maps polar angle to image pixels
- Extract parameters from image, or from raw data



TRACE FLOOR PLAN AND EXTRUDE ROOM

- Import a pdf drawing, or hand sketch
- Point and click on wall boundaries in field of view
- Identify detector location and view direction
- Enter ceiling height (or other fiducial reference)
- Enter detector height and inclination
- Extrude basic backdrop of the image in 3D space



VERIFY AGREEMENT

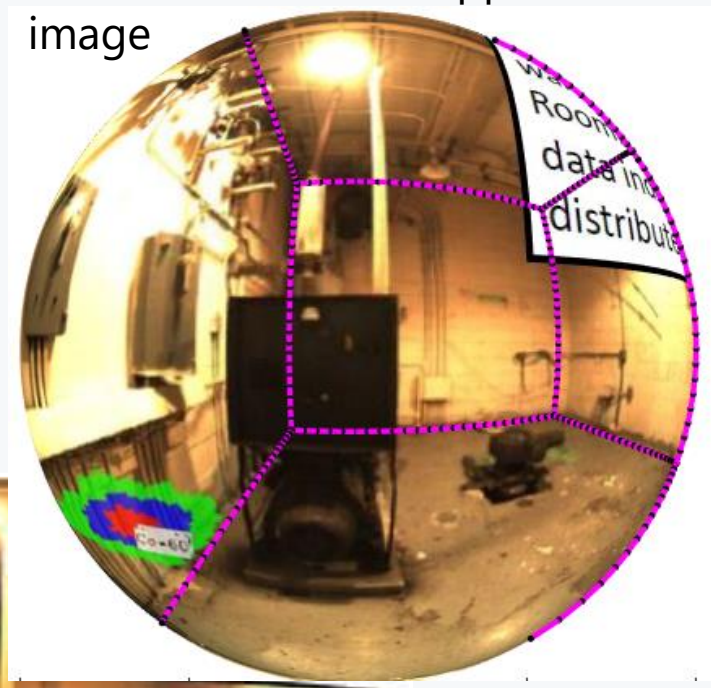
User Functions

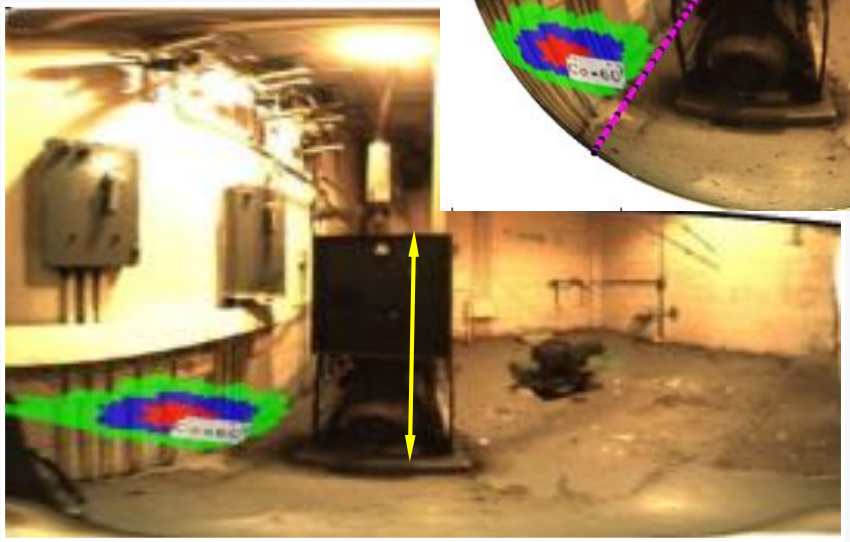
- Image rotation
- Mercator / Lambert projections to remove distortion
- Select / measure image features

Key Parameters

- Camera location and orientation
- Spatial scale

Room boundaries mapped to image

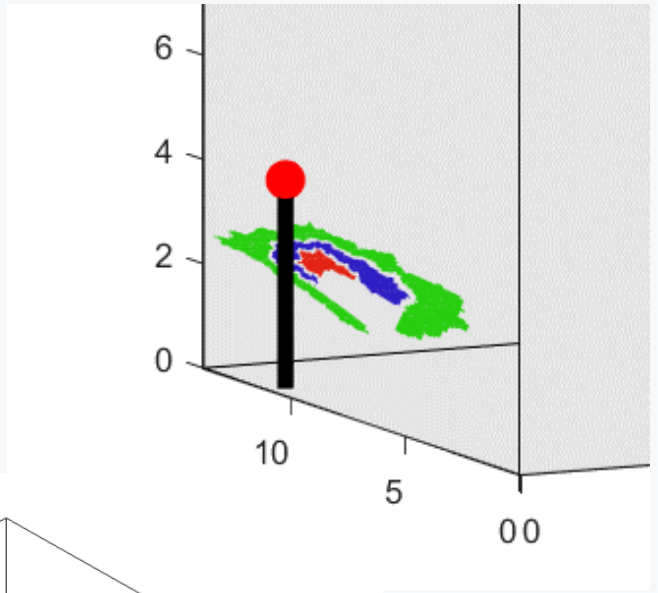


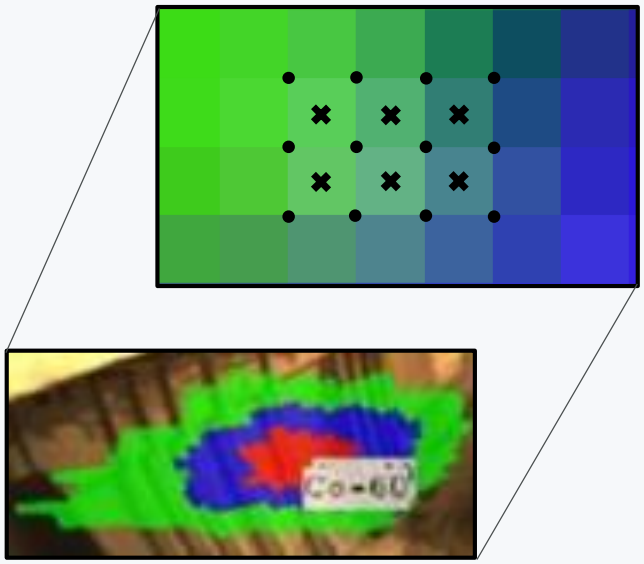


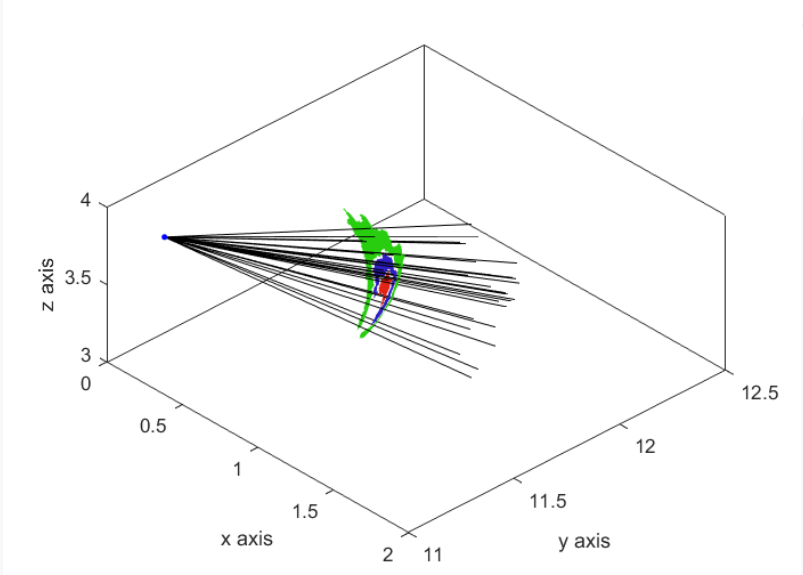
Lambert projection to map view

EXTRACT CONTOURS AND PROJECT

- Select contamination pixels from image
- Determine direction using image center and lens function
- Project outward onto 3D surfaces

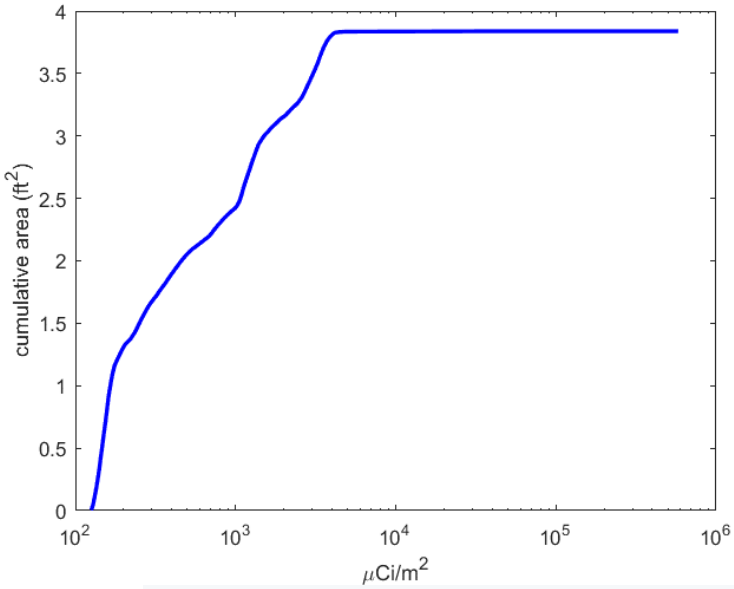


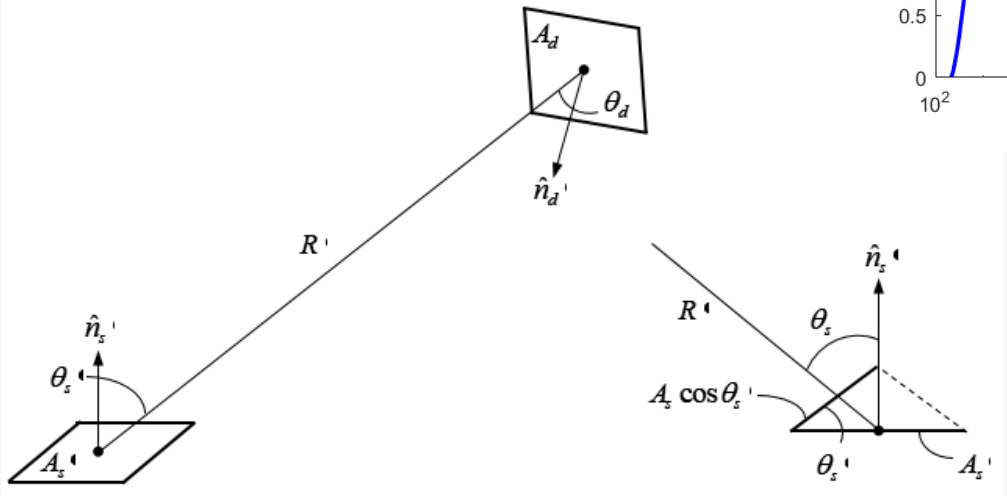




RADIATION TRANSPORT CORRECTIONS

- Intensity at the detector is not the same as intensity at the source
  - Spatial attenuation
  - Scatter in air
  - Self shielding at source
  - Intervening materials





- Cost of decontamination and waste disposal scales with area and rad intensity

FIELD STUDY

- EPA planning to exercise data acquisition and analysis methods in cooperation with Kansas State University Department of Nuclear Engineering
- Live-source imaging in variety of perspectives emulating surface sources in industrial settings
- Practice and improve field technique
  - Detector position / orientation relative to surroundings
  - Build experience with detector operation including exposure time vs source intensity and distance
  - Establish data stream to post-process contamination area
- Validate area processing methods
  - Verify optical lens function
  - Reconstruct known areas at oblique angles
  - Identify potential limitations / uncertainties

TOOL ENHANCEMENT

- Will streamline the processing of the 2-D gamma-ray imagery
- User interface will package user actions in a module to:
  - Trace or import room dimensions
  - Import, rotate, and select image features (fiducial scale)
  - Identify contamination pixels (possibly automated)
  - Project contamination and calculate surface area (possibly automated)
  - More automation raises opportunity for batch processing
- Integrate module's contamination analysis output with the Integrated Rad Remediation Decision Support Tool (IRRD-ST)
  - Improve estimates to inform remediation strategies

NEXT STEPS

- Plan and conduct field study
  - Will provide data stream to process methods and allow for experimental feedback / refinements
- Refine methodology, as needed, based on results of field study
- Build module and program features to process imagery and extract contamination area estimates
- Integrate module into the IRRD-ST for estimating decontamination costs

DISCLAIMER

The U.S. Environmental Protection Agency, through its Office of Research and Development, is funding and managing the research described here under Contract #EP-C-16-015 to Eastern Research Group. Final publications will be subject to the Agency's review process.

Questions should be addressed to:

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