Listening for Radiation Spectra: A Flexible Radiation Surveying System Based upon Sound Card Spectrometry and Open-source Coding on a Single-Board Computer

Caleb M Bush (Senior), University of Michigan, Radiological Health Engineering Laboratory

Prof. Kimberlee J Kearfott, Ryan A Kim, Clay D Hudson, Jacob R Wiest, Jordan D Noey

University of Michigan Radiological Health Engineering Laboratory

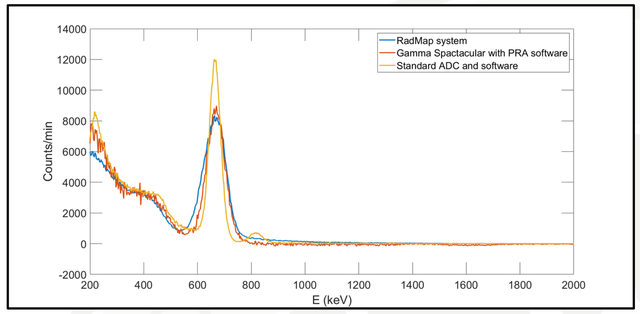
Introduction and Motivation

- Most radiation detection and surveying systems are closed systems
- Little access to raw data or ability to modify the system
- Reliable, but inflexible, expensive and difficult to integrate
- ***Rad-Map provides an affordable platform for interpreting detector data using entirely open source software with total system control***

Mission Relevance

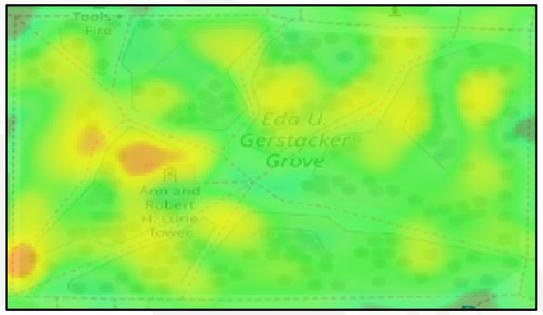
- Easier development of new radiation monitoring systems
- Such systems critical to non-proliferation and emergency response
- Greater knowledge of background radiation
- Affordable outreach instrument

Results



Cs-137 spectra taken through two sound card systems and one MCA system.

Hardware	Software	Cost	FWHM
DT5730 Digitizer	CoMPASS	$9,058	7.5%
Gamma Spectacular	PRA	$399	12.2%
Gamma Spectacular	Rad-Map	$399	15.3%



Map of radiation field in Eda U. Gerstacker Grove using Rad-Map system.

- Sufficient stationary GPS resolution for environmental mapping (accurate within ~3 m)
- GPS loses accuracy with speed
- Created live data display for survey purposes
- Sampling rate limits energy resolution

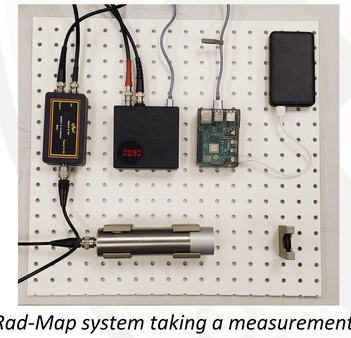
Map of radiation field in Eda U. Gerstacker Grove using Ludlum model 12s survey meters with Counts-Pro mapping software.

Lurie Tower

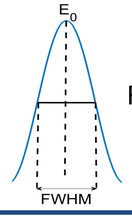
Tau Beta Pi marker

Technical Approach

- Relies on a commercially available sound card gamma spectroscopy system (Gamma Spectacular GS-PRO-V5)
- 1.5 in x 1.5 in NaI(Tl) scintillation crystal
- In-house Python scripts written to handle detector and GPS data
- Full width at half-maximum (FWHM) used as figure of merit to optimize system
- Spectra taken with Rad-Map software on a Raspberry Pi and provided software on a laptop, and by COMPASS software on a multi-channel analyzer
- Maps made of radiation on North Campus using Rad-Map and Ludlum Model 12 survey meters with Counts-Pro software



Rad-Map system taking a measurement



$$\text{Resolution} = \frac{\text{FWHM}}{E_0}$$

Expected Impact

- Further development of other lab research opportunities (Radiation mapping drone and radiation weather station)
- Enhanced environmental radiation mapping
- Affordable high-school and public outreach device

MTV Impact

- Gained understanding of real-world radiation monitoring situations
- Experience in public speaking and technical presentations
- Received programming experience
- Performed radiation protection training

Conclusion

- Able to provide reasonably accurate mapping and spectroscopy data in a cost-efficient system
- Useful/easy integration with mobile systems
- Spectroscopy capabilities limited by maximum sampling rate

Next Steps

- Further research with other detectors
- GPS improvements
- Improve energy resolution and dead time
- Address indoor mapping capability

Acknowledgements

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