RadiaCopter

UAS Gamma Spectrometry for Detection and Identification of Radioactive Sources

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expanding reality

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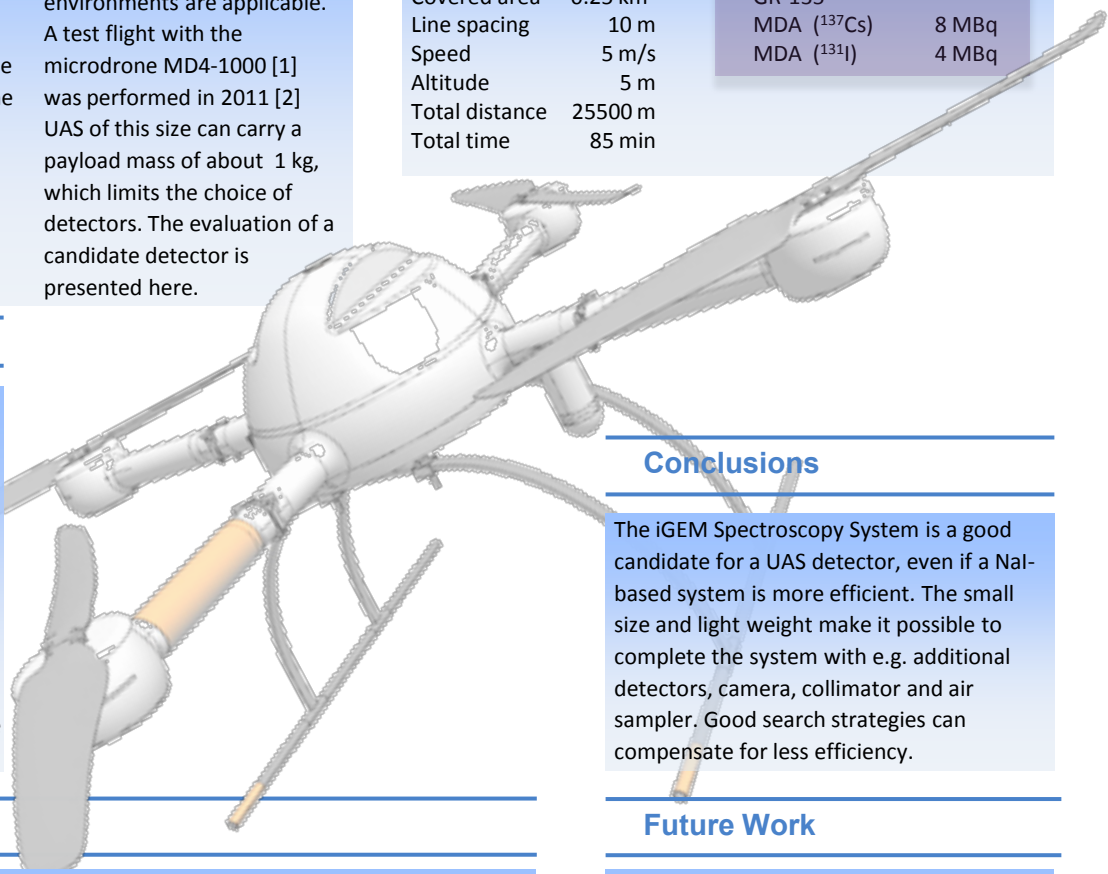
Introduction

This project aims to develop a gamma-ray spectrometry system with an unmanned aircraft system (UAS). This system fills a gap between portable measurement systems and full-sized airborne systems, and complements the car-borne measurement systems.
Sources can be approached closely, providing good sensitivity with a relatively small instrument. The operating range allows for measurements to cover a large area in less time than e.g. portable systems. Urban environments are applicable.
A test flight with the microdrone MD4-1000 [1] was performed in 2011 [2]
UAS of this size can carry a payload mass of about 1 kg, which limits the choice of detectors. The evaluation of a candidate detector is presented here.

Applications

- **Survey NPPs**
- **Search for orphan sources**
- **Secure public areas**
- **Identify sources with high dose rate**
- **Survey accident sites**
- **Survey container sites**
- **Geophysical surveys**

The UAS also provides footage of the source and site.



Detector evaluation

The iGEM Spectroscopy System [3] was considered a suitable detector given the low weight (288 g) and the turnkey configuration. The system uses a CdZnTe detector. The evaluation approach was to calculate the MDA for a given speed and altitude for the system. Count rate efficiencies were measured with two sources (^{137}Cs and ^{131}I) to cover a wider energy range.
The count rates at specific positions passing a point source were calculated by distance and air attenuation.
A scenario was setup to give an idea of the detection limit for the system.
The detector was compared with a handheld RIID, the GR-135 [4], with a 4 cu. in. NaI detector.

Detector evaluation results

Count rates at the full energy peaks at 364.5 keV (^{131}I) and 661.6 keV (^{137}Cs) [5].

Covered area	0.25 km^2
Line spacing	10 m
Speed	5 m/s
Altitude	5 m
Total distance	25500 m
Total time	85 min

iGEM	
MDA (^{137}Cs)	38 MBq
MDA (^{131}I)	19 MBq
GR-135	
MDA (^{137}Cs)	8 MBq
MDA (^{131}I)	4 MBq

Conclusions

The iGEM Spectroscopy System is a good candidate for a UAS detector, even if a NaI-based system is more efficient. The small size and light weight make it possible to complete the system with e.g. additional detectors, camera, collimator and air sampler. Good search strategies can compensate for less efficiency.

Future Work

- Aircraft vehicle evaluation
  - Scandicraft [6]
- Detector evaluations
- Multidetector system
  - β/n detection
  - Air sampling
- Search strategies
- Validation
  - Exercises
  - Calibrations
- Data management and presentation
  - Deviation display [7]
  - Presentation in Google Maps/Earth
  - Info sharing
- Monte Carlo simulation of the system

References

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[7] Kock, P; Finck, Robert R.; Nilsson, J. M.C.; Östlund, K.; Samuelsson, C. A deviation display method for visualising data in mobile gamma-ray spectrometry. Applied Radiation and Isotopes 68 (2010) 1832–1838
Image in the background [1]

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