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PREPAREDNESS
Metrology for mobile detection of ionising radiation following a nuclear or radiological incident.

EMPIR EURAMET
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Preparedness European Project:
Metrology for mobile detection of ionising radiation following a nuclear or radiological accident.

WP1 unmanned aerial systems

http://www.preparedness-empir.eu/

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Objective

The aim of this work package is to **develop**, **test** and **validate metrologically-traceable systems and methods** for remote measurements of **ambient dose** equivalent rates and **radionuclide ground concentrations** using rotary-wing unmanned aircraft systems (**RWUAS**), commonly named 'drones', **with spectrometry systems** mounted on them.

Tasks and activities

Review

Task 1.1: **Current Status**

i) Define characteristics: nuclide vector, detection limits, spectrum, time integration, speed, autonomy,.... **scenarios**

ii) Review information:

- Drones and helicopters
- Airborne monitors
- Operational software
- Transmission technologies
- Data formats
- Regulations
- Aerial sites and sources

Development

Task 1.2: **Development of UAMS**

i) Mount monitors on UAVs

ii) Characterization by MC

iii) Experimental test in preliminary flights

Task 1.3: **Development and optimization of software ..**

i) For gamma spectrum analysis, $H^*(10)$ and radionuclide concentration calculation

ii) To define on-board calculation in order to optimize data transmitted to ground station

iii) To write and read spectra according to standard formats

iv) To auto-fly to hotspot locations

Measurements campaigns

Task 1.4: **Development of test and calibration procedures**

i) Radiologically characterize selected flight sites

ii) Design source and MC fluence simulations

iii) Calibration procedures

Task 1.5: **Measurement campaigns**

i) Barcelona Drone Center (Barcelona)

ii) Seelingstädt (Thuringia, Germany)

iii) military area in the Czech Republic

iv) BR1 research reactor at SCK•CEN

UAVs and detectors

Small drone
Flight time: ~ 10 min
Payload: few grams.

Frame Tarot X6
Flight time: ~ 10 min
Payload: ~2.5 kg.

Copterworks
Patrol engine
Flight time: close to 1 hour with payload of about 4 kg

Tested

In selection process

IJS

HPGe ~ 21 kg

CZT (1cm3)
~ few grams

NaI, CeBr3, LaBr3
2" x 2" ~ 1 kg

Localizator ~ 2 kg

UAVs and detectors

Two main possibilities for mounting a detector in a UAS are investigated :

i. **Stand-alone detector:**

   a. The detection system includes also devices to make a complete stand -alone system (data transmission, GPS, height,.....). These devises are duplicated.

   b. The data send to ground by the drone is merged with the detector data in the ground-station (harmonization of data format).

ii. **The detector is integrated into the drone architecture:**

   - The computer installed in the drone asks to the detector for the counts in each energy bin, time-stamp and life-time. These data are merged with the drone data in a synchronized time.
   - Then, data are compressed and send to the ground station, where are visualized in-real time by a graphical interface.
   - On-board, the complete information of the acquired spectra is saved for further analysis with devoted spectrometric analysis codes.

Aerial sites

Example aerial site Villanueva, Zaragoza (Spain):

Surface: 1km x 0.35 km

Control building

Non-Visual flights: ~ 5 km²

Hangar

Preliminary Flight in Pla del vent aerial site

Tc-99m point source of 3.6 MBq located in an area of about 50m x 50 m

Integration time: 2.5 s

Altitude: from 2 m to 10 m

Speed: from 2 m/s to 5 m/s

RIMA-Spec code is used for mission definition, data acquisition, on-board calculation, data send and on-line visualization

Conclusions

The main outcome of WP1 are:

i. Summary report on the spectrometric systems developed for monitoring in the aftermath of a radiological event and mounted on a UAV, including the development of software and tools for data acquisition, processing, transmission and analysis.

ii. Recommendations on the measurement of dose rates and radioactivity ground concentrations using UAV based spectrometric systems including dedicated calibration procedures

The improvement of the monitoring system using UAV and its harmonization is necessary to include data in decision maker system such RODOS. This could be analyzed in the framework of NERIS and EURADOS

EMPIR 16ENV04 „Preparedness“ Kick-off meeting