Unmanned Aerial Vehicle for the Measurement of 3D Electromagnetic Fields Distribution

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Measurement of three-dimensional spatial Electromagnetic Fields for:

- Radiation pattern analysis
- Electromagnetic safety
- Electromagnetic pollution
- Electromagnetic compatibility

Requirements for EMF Spatial Distribution measurements:

- Track the measuring position
- Large scale systems
- Robot-arms

Large costs, amount of time and manpower. Constraints in terms of the considered volume for the measurement.
General framework

Proposed approach based on:

Unmanned Aerial Vehicles (UAV)

Selective Electric Triaxial Antenna (SEP)
Overview on the system

Hexarotor (UAV):

Some features:
- Flight time 20 minutes
- Automatic Flight with set of the mission from PC or tablet, automatic take-off and landing
- Flight for experienced users with remote control for access in areas without GPS
- Digital Telemetry
- Capacity load (payload) of 6 Kg
- Operative Range: 5km

Mission Planner and Flight Controller interfaces:

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Overview on the system

Selective Electric Triaxial Antenna (SEP)

- Frequency range 10 MHz - 3 GHz
- No coaxial ferrite cable
- No isotropy error
- Calibration certificate
- Detectors: Peak, Average, RMS and channel power
- Measurement range @ 10 - 100 MHz = 0.1 V/m;
  @ 0.1 - 2 GHz = 0.02 V/m;
  @ 2 - 3 GHz = 0.09 V/m;
- Weight 370 g
- Dimensions 140 X 140 X 140 mm
- High-energy batteries replaceable
- Fiber optic connection to the PC
- Operating temperature from 0° C to 50 °C

Dedicated software:
- Real time measurements
- Possibility of applying filters (channel power)
- Possibility of setting markers
- Display the signal with 3 overlaid axis
System Set-Up

SEP on board installation:
- Study of weights and position
- Keep invariant drone barycenter
- Ensuring low signal interference

Use of glass-fiber material with no-magnetic and no-reflective properties

Data Link between SEP and GS:
- Attenuation
- Reflection
- Distortion

Use of optic fiber 80m length
System Set-Up

Use of Anechoic Chamber:
- System interference analysis
- SEP calibration

Operative configuration:
- Motor Running
- Telemetry Rx/Tx
- Pilot Controller Rx/Tx

Negligible interference: 0.1 V/m
Measurement on broadcasting TLC tower:

- Distance ≈ 300m
- Flight Height: from ground to 20m
- Scanning Frequency Range: 750MHz to 950 MHz (GSM)
- Signal Peak value ≤ 1V/m
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Conclusions

- A new technique based on UAV vehicle and SEP instrument for the 3D measurement of EMF in volume of large dimensions has been presented;
- The system has been made up and calibrated using anechoic camber environment and no interference signal from UAV vehicle has been detected;
- The validation activities on TLC tower show results consistent with the expected values;
- Potential of application in dangerous or not easily accessible areas, critical condition for human operations.

Next activities:
- Improvement of system introducing ad-hoc wireless datalink between SEP and ground station;
- Test in more complex scenarios with production of EM pollution maps;
Thanks for the attention,
Any comments or questions?