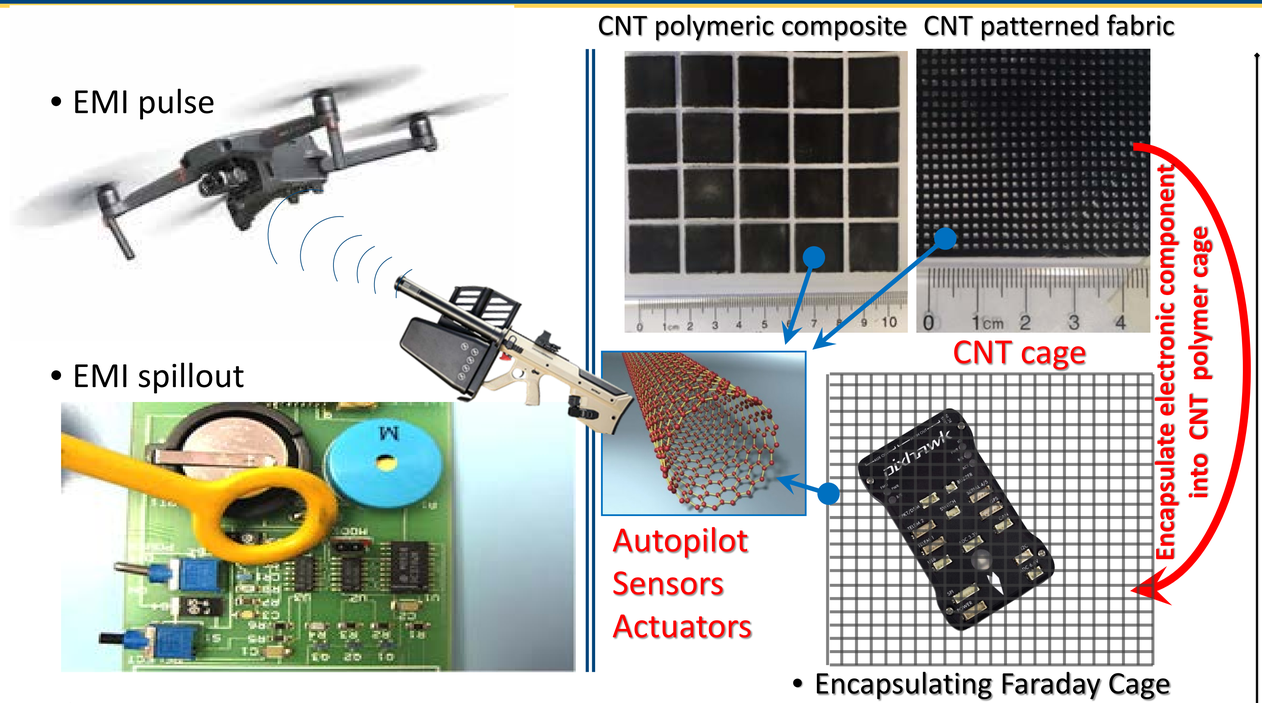
Evaluation of Novel Carbon Nano Tube Materials for Defeating Counter UxS Methods by Enabling EMI/RFI/ESD Shielding

CRUSER
Consortium for Robotics and Unmanned Systems Education and Research



Objective

- Onboard instrumentation of UxV systems across all domains suffers from lack of EMI/RFI/ESD protection. This presents 2 major vulnerabilities:
  - UxV own electromagnetic filed might adversely affect the onboard command and control (C2) links and sensitive payloads
  - The EW and counter UxV methods not only block the communication capabilities but also lead to the fatal burn out of onboard instrumentation
- The need for novel methods of protecting onboard microelectronics is urgent and can be provided by the integration of carbon-based nanomaterials.
- Traditional increase of the thickness of metal foils used in protection layers violates SWAP constraints and defeats other advances including the onboard intelligence.

Deliverables

- The experimental setups and the measurement protocols description that verify:
  - the choice of the CNT material and the engraving pattern
  - the achievable levels of RF energy attenuation as function of chosen CNT engraving or composite pattern,
  - a parameterized mathematical model that designs the EMI protective shield as the function of “hostile” signal (power & frequency) and the desired characteristics of the EMI shield.
- A detailed procedure that outlines the integration steps; from raw materials to limited volume conformal shapes of UxV.
- Comparative map of the RF anechoic vs the open field experimental results.

Technical Approach

- Design and fabricate novel carbon nanotube (CNT) patterns to be integrated into small unmanned systems to enable EMI protection of onboard instrumentation of UxV systems.
- Explore the achievable levels of EMI protection due to novel properties of CNT fabric and various methods of its fabrication and integration onboard:
  - Design a practical guide for generating the CNT patterned structures that will act as EMI shield.
  - Experimentally verify the benefits of EMI protection. Explore achievable levels of EMI protection suitable for integration onboard of small UxV.
  - Develop a fabrication procedure that integrates CNT-based EMI shield into limited volume conformal shapes of UxV.

NPS PRAESTANTIA PER SCIENTIAM

FY20 Call for Proposals

PI Vladimir Dobrokhodov
Mechanical and Aerospace Engineering
vndobrok@nps.edu

Co-PI Claudia C. Luhrs
Mechanical and Aerospace Engineering
ccluhrs@nps.edu

Co-PI Paul Leary
Department of Physics
pleary@nps.edu