Extending the Endurance of Multi-rotor UAVs with Boron Nitride Nanotube (BNNT)-based Piezoelectric Composites

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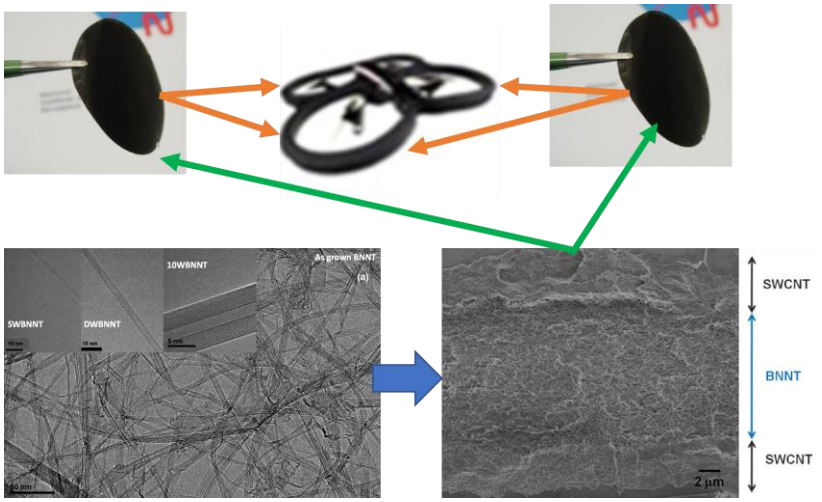

Multi-rotor UAV integrated with BNNT composites to increase endurance and range of UAVs through vibrational energy harvesting. Images adapted from [1], [2].

Problem Statement

- This research will attempt to increase flight endurance of multi-rotor UAVs by integrating boron nitride nanotube (BNNT) based piezoelectric composites into the airframe.
- Whether or not the BNNT composites will harvest sufficient vibrational energy to reduce the load on the batteries will be explored.
- The composites will be fabricated by traditional means or through additive manufacturing in the case of BNNT-polymer composites.
- Follow on research will look at printing entire UAVs with BNNT composites printed directly in the airframe.

Impact

- This work could demonstrate the feasibility of integrating BNNT composites into UAV frames for energy harvesting.
- Long-term durability of PVDF polymer composites could be studied.
- Increasing the endurance of UAVs through energy harvesting could increase range and operational time of UAVs during reconnaissance missions or make further miniaturization of drones possible like for swarms.
- Success will be measured by integrating BNNTs into the UAV frame and increasing the flight time of UAVs modified with BNNT energy harvesters.

Transition

- This work aligns with the DON's stated desire for "smaller and more numerous" and more capable UAVs.
- A desired end-state in the Unmanned campaign framework, is to increase the range, endurance, and persistence of UAVs. This is the goal of this research.
- ONR program managers: Jennifer Wolk, Dr. Antti Makinen, and Sarwat Chappell oversee programs that align with research in BNNT composites.

References:

[1] J. H. Kang et al., ACS Nano, vol. 9, no. 12, pp. 11942–11950, 2015.
[2] R. A. Sowah et al., IEEE Trans. Ind. Appl., vol. 53, no. 5, pp. 4965-4972, 2017.

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