

Inflight Wireless Energy Harvesting from Power Lines for Autonomous Battery Recharging Onboard Miniature UAVs with Neuromorphic Intelligence

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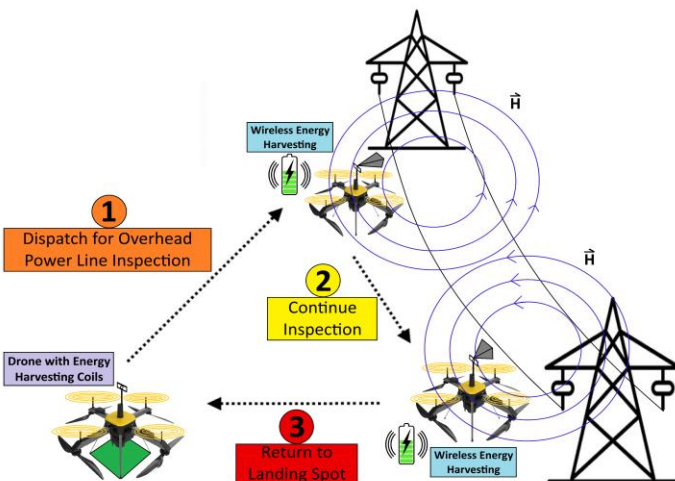
INTRODUCTION

Traditional unmanned aerial vehicles (UAVs) are power-hungry and result in the quick depletion of batteries. This research seeks to replenish batteries on UAVs by harvesting energy from free-standing electromagnetic field around powerlines. To minimize energy consumption by UAVs, neuromorphic systems and algorithms will be incorporated.

RESEARCH QUESTIONS

- 1 How much energy can be harvested from powerline magnetic fields via tiny coils?
- 2 What design considerations exist for end-to-end neuromorphic pipeline on UAVs?
- 3 What are the battery recharge rates from harvested energy during UAV's flight?

CONCEPTUAL FRAMEWORK



- UAV is made light & low power consuming
- Event-based vision leads UAV to power line
- UAV adjusts its proximity to power cable
- Vision-based control aids cable inspection
- Harvested energy replenishes UAV battery
- UAV returns to landing spot after mission

METHODOLOGY

1st Work Package → Electromagnetics

- Determine magnetic field close to powerline
- Design coils for efficient energy harvesting
- Construct charging circuit for UAV battery
- Test energy harvester during UAV flight

2nd Work Package → Neuromorphic Vision

- Construct event-based data of powerlines
- Train spiking neural network (SNN)
- Deploy network on neuromorphic chips
- Test neuromorphic vision during UAV flight

3rd Work Package → Neuromorphic Control

- Perform power management with spike train
- Build a SNN-based flight controller
- Drive motor via pulse frequency modulation
- Test spike-based control during UAV flight

4th Work Package → Integrate & Evaluate

- Assemble components on single PCB
- Adjust energy harvesting coils on UAV
- Show autonomous inflight energy reaping
- Document increase in mission time of UAV

5th Work Package → Supplementary Trials

- During inflight energy harvesting, vary:
 - ✓ Flight velocity and payload weight
 - ✓ UAV's orientation and position
- Attempt levitation of UAV on powerline
- Detect faulty powerlines from field readings

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