

Improving UAS operations near transmission lines by sensing electromagnetic field data in flight

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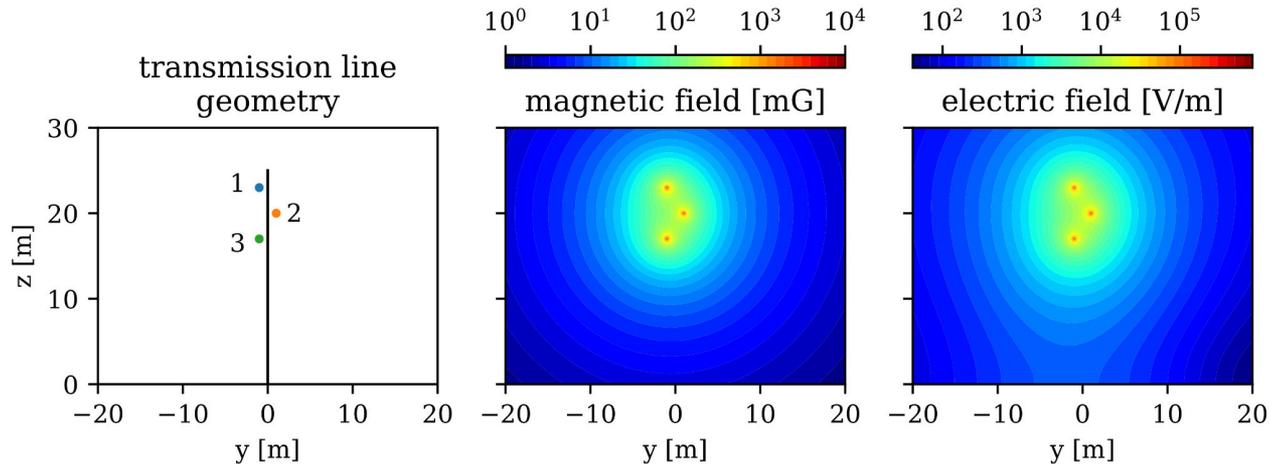
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EMF is an untapped datastream for UAS operations

Energized transmission lines emit electric and magnetic fields at a distinct, known frequency:

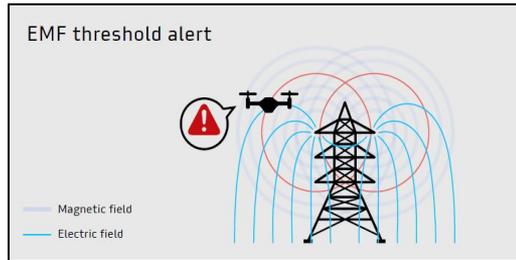
- These fields are typically viewed as a nuisance for UASs, potentially causing sensor noise and negatively affecting flight stability
- However, the EMF emanating from transmission lines is relatively predictable and can be modeled



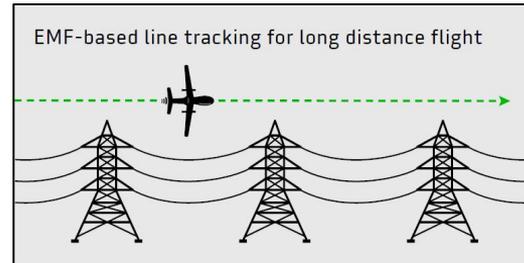
How can EMF data be useful for UASs?

By sensing and electric and magnetic field data in flight, transmission lines can potentially act as an active beacon for UAS localization

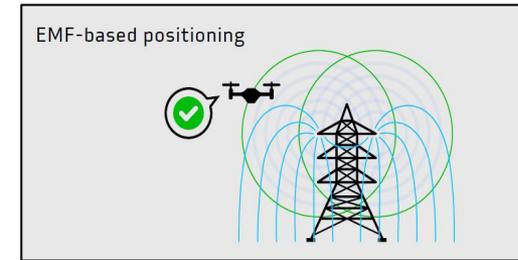
Manifold Robotics is currently developing a technology to enable the following actions for UAS-based transmission line inspections using EMF data



Detection and avoidance



Power line tracking



Automate drone positioning

Sensing and analyzing EMF data in flight

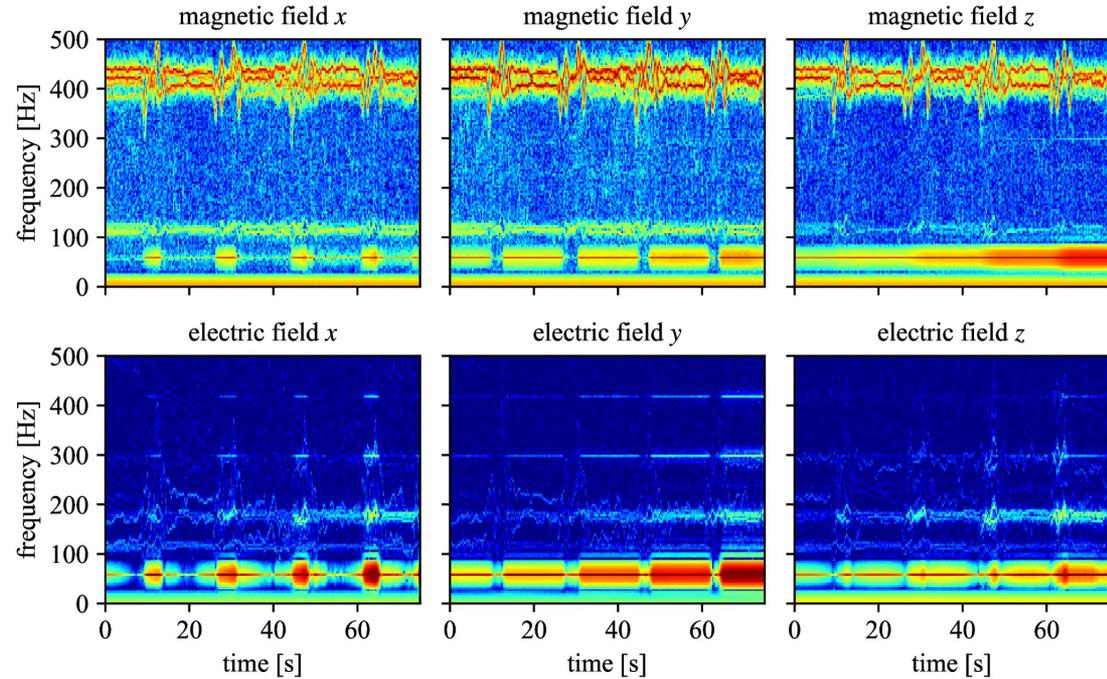
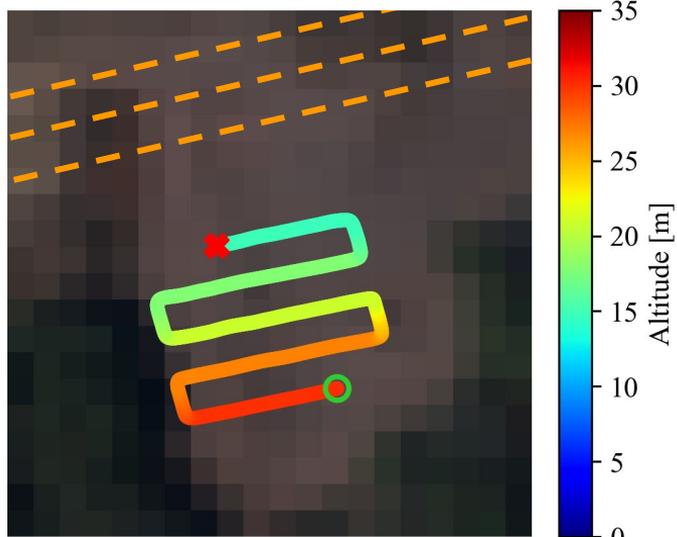
Proprietary sensing technology for measuring electric and magnetic field data in 3 dimensions, while also minimizing impact of electromagnetic interference generated by the UAS.



Electric field
sensor

Magnetic field
sensor

Sensing and analyzing EMF data in flight



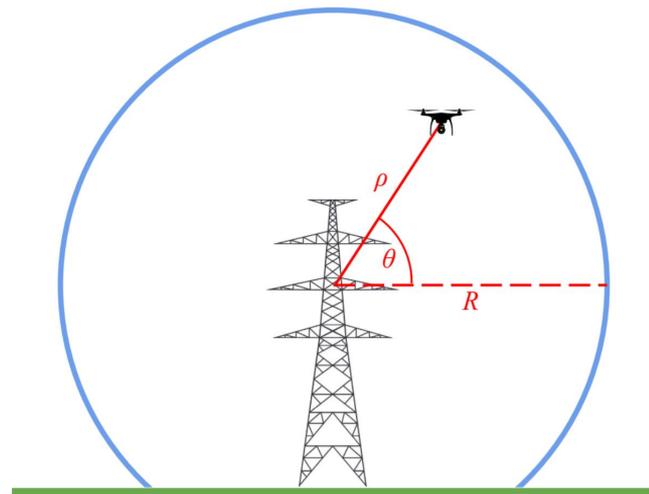
Sensing and analyzing EMF data in flight

From this data, we can:

- Estimate the transmission line heading
- Estimate distance from transmission line
- Estimate angular position along transmission line

How can this improve the inspection workflow?

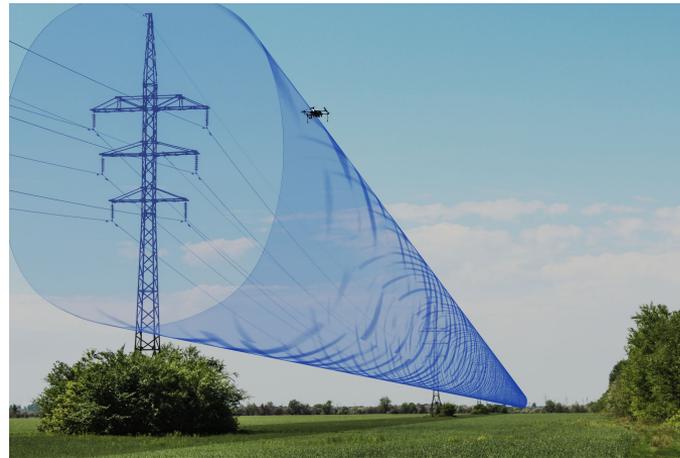
- Avoid transmission line collisions
- Automate/semi-automate shot-sheet positioning
- Automate/semi-automate patrol inspections



Safety and automation during inspections

EMF tells the UAS its relative position to the power line

- Detection and avoidance based on pre-defined MAD
- Automated and semi-automated inspections without pre-flight planning
 - Semi-autonomous mode allows pilot to control drone with EMF guidance
 - Autonomous flight executes missions using pre-defined positions relative to line

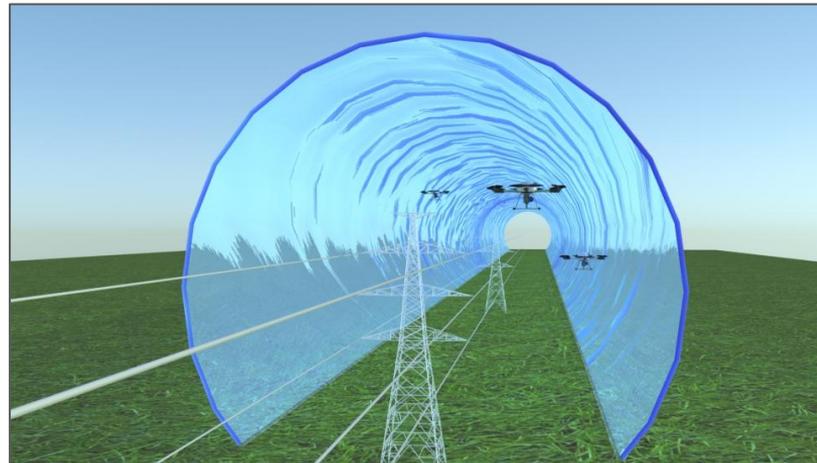


MAD based on EMF threshold set by user

Long distance operations

Enable safe and robust long-distance flight along power transmission lines

- Use EMF data to set thresholds that the drone cannot fly outside of
- Ensures containment of UAS position away from surrounding airspace and infrastructure
- Applies to manual and autonomous flight modes



Virtual drone corridor based on EMF

Advantages

- EMF-based positioning can serve as a GPS backup
- Does not require extensive mission planning or 3D data
- Adaptable for pilot needs with autonomous and semi-autonomous flight modes
- EMF sensing hardware is relatively lightweight
- Does not rely on lighting conditions for detection and avoidance
- Computational load for processing EMF data is low: small, lightweight onboard computer for data processing

Acknowledgements

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