PhD defense

by

Frederik Falk Nyboe

Defense title:

"A Framework for Field Operation of a Powerline Inspection and Interaction Drone System"

Date: 23rd January 2026
Place: Ellehammer Ø28-600-3
Time: **12:00**

Chairperson
Associate Professor **Tim McRae**, Digital and High Frequency Electronics, Institute of Mechanical and Electrical Engineering, University of Southern Denmark

Supervisor
Professor **Emad Samuel Malki Ebeid**, Digital and High Frequency Electronics, Institute of Mechanical and Electrical Engineering, University of Southern Denmark

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A Framework for Field Operation of a Powerline Inspection and Interaction Drone System

Popular Scientific Abstract

Frederik Falk Nyboe

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As society becomes increasingly electrified—with electric vehicles, large data centers, and renewable energy sources—the demand on the electrical grid is growing rapidly. This puts pressure on an already aging infrastructure, much of which relies on overhead powerlines. Regular inspection and maintenance are essential to keep the grid reliable, but traditional methods using cranes or helicopters are expensive, risky, and labor-intensive. Drones offer a promising alternative, capable of inspecting and even interacting with powerlines more efficiently and safely.

This PhD project develops and demonstrates a drone system designed to perform powerline tasks autonomously in the field. The work focuses on making drones capable of flying safely near cables, identifying their surroundings, and even landing directly on the cables to recharge their batteries or perform maintenance actions. Achieving this requires reliable sensing, precise control, and a high level of onboard decision-making.

The project resulted in a complete system that combines these capabilities. It uses radar and camera to detect and locate powerlines, advanced control methods to fly and land accurately, and an autonomy system that allows the drone to plan and execute missions independently. The system was built and tested over two major development stages, each improving sensing, control, and mission logic.

The final system was successfully tested in real-world environments, where the drone demonstrated fully autonomous flight and cable landings, including a long-duration mission powered by self-recharging from the cable. These results show that autonomous drones can one day become a practical tool for inspecting and maintaining powerlines, reducing costs and improving safety for critical electrical infrastructure.