# Safe and Efficient Inspection of Power Lines using UAVs

# Background

Given the development of renewable power generation plants, the need for a higher capacity reliability of electrical energy distribution and transmission networks is continuously increasing. As the construction of new power lines usually causes popular discontent and protests, maintenance of the existing network is even more important [7]. In the past, power lines were inspected by ground patrols and highly skilled personal climbing the wire racks. Later, ground patrols would be augmented with visual inspections using helicopters. Considering the sheer size of today's power grids (more than 650.000 km of medium- and high-voltage lines in Germany alone<sup>1</sup>), this approach is not only risky for the crew but also very expensive and not reliable [7, 9]. Recently, unmanned aerial vehicles (UAVs) such as autonomous drones have attracted a lot of interest as a cost and time efficient solution that allows to inspect energized power lines safely [3, 9].



Autonomous drone inspecting a power line (Image from https://preformed.com/inspection-services).

## Description

After detecting the power line based on measurements of the electric and magnetic field, the drone has to track the power line. In this thesis, a model predictive controller (MPC) should be designed for this task. MPC, which is a popular control approach for UAVs [6], has the ability to explicitly consider constraints on the control inputs and states, such as avoiding collisions with the poles.

The goal of this thesis is to apply the MPC approach in [8] to the power line inspection task. All programming will be done in MATLAB. **Depending on your progress, you will have the possibility to evaluate your implementation on a real drone!** 

This thesis is carried out in collaboration with E.ON Future Lab and provides you with the opportunity to get to know an advanced control algorithm that provides safety guaratees.

#### Tasks

- Familiarization with MPC and the approaches in [1, 8].
- Familiarization with autonomous power line detection [5, 2, 4].
- Identificaton of a suitable model of the drone and suitable safety constraints.
- Adaptation and extension of the robust MPC approach in [8] to the power line inspection task (focusing on real-time capability of your implementation).
- Evaluation of your implementation.



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**Research area:** Power systems, control theory, formal methods

**Programming language:** MATLAB

**Required skills:** Background in control theory and dynamical systems.

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<sup>&</sup>lt;sup>1</sup>https://de.statista.com/statistik/daten/studie/37962/umfrage/ laenge-der-stromnetze-in-deutschland-in-1998-und-2008/

- Optional: Implement your algorithm on a real drone!
- Documentation of the results.

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