INTELLIGENT DRONE GRASPING MECHANISM FOR POWER LINES

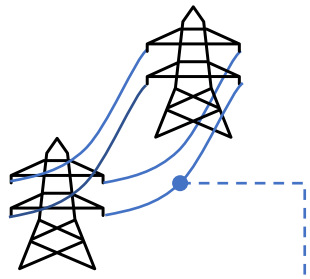
Ph.D. Student: Viet Duong Hoang, vdh@sdu.dk

Principal supervisor: Professor Emad Samuel Malki Ebeid

Co-supervisor: Associate professor Aljaz Kramberger

I. Introduction

According to [1], the total length of power transmission lines in Europe equals 26 times the distance from the Earth to the Moon. AERIAL-CORE project granted by European Union's Horizon 2020 research and innovation program aims to employ drones for continuous inspecting and to maintain high voltage power transmission lines. Multi-rotor drones can fly within closer proximity to pylons compared to helicopters, and work much more frequently than humans. Moreover, power lines are an unlimited power source that drones can land on and recharge batteries from electromagnetic energy around cables. This PhD project mainly focuses on landing and recharging systems on power cables.



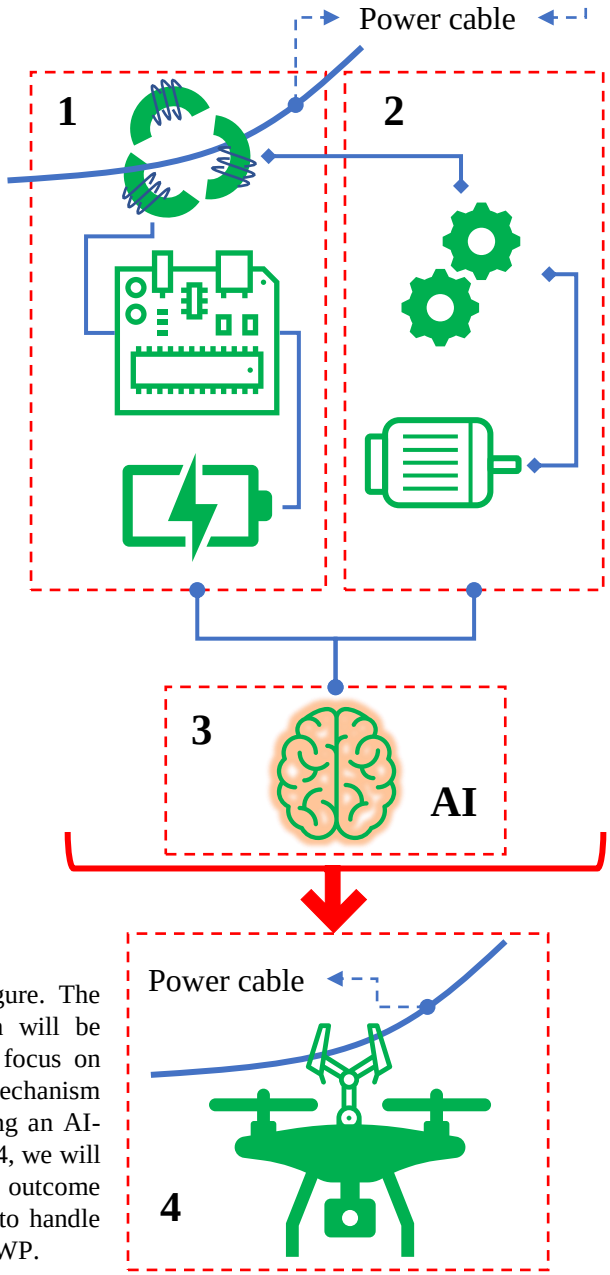
II. Aims of the research

Extracting power from the magnetic field around cables using split magnetic cores is a promising approach compared to the electric field. Some of the related work was already done but magnetic cores were quite heavy, and no research clearly analyzed the impacts of core characteristics on harvested power [2][3]. In addition, the efficiency of the power converter should be taken into account. Therefore, in this PhD project, the author aims to accomplish the following tasks:

- Investigate the influence of magnetic core's characteristics on harvested power and select more lightweight cores.
- Improve the efficiency of the power converter (AC to DC) and MPPT circuit.

Some research developed grippers using motors and pneumatic mechanisms, enabling drones to hang from power cables to harvest energy by magnetic cores [3][4]. However, these bulky systems add much weight to the drones. This PhD project aims to utilize the inductive core as the grasping manipulator. We can do this because the electromagnet force is generated inside the core to pull two halves towards each other when currents are flowing inside power cables. In this PhD project, the author expects to complete the following goals.

- Design an automatic and adaptive gripper that continuously sense the power line current to adjust the holding force by controlling the winding's current.
- Investigate the influence of winding's DC current on the charging process.
- Release mechanical design of gripper. This design can grasp the power line firmly using a bird-like perching mechanism.
- Develop an AI-based algorithm to control actuators to grasp the cable based on the required holding force



III. Methodology

The methodology of this PhD project is illustrated in the right Figure. The project is divided into four different work packages (WP), which will be implemented in sequence. WP1 involves electrical engineering; we focus on designing the energy harvester. We will then propose a mechanical mechanism to open/close the magnetic core in WP2. WP3 is related to developing an AI-based algorithm to control the charging process and the. In the last WP4, we will integrate all components into drones and perform real flight tests. The outcome of the current WP works as the input of the next WP. It is possible to handle problems of the current WP by improving the outcome of the previous WP.

SDU University of Southern Denmark

AERIAL -CORE

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