Advanced Aerial Manipulation
for Infrastructure Maintenance

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Background:

Aerial manipulation is an advanced field of robotics that combines flying platforms, like drones, with robotic arms or end-effectors to perform tasks that involve interacting with objects in the environment. Unlike traditional drones, which are typically used for observation or data collection, aerial manipulators can physically interact with their environment, such as grasping, moving, or assembling objects in mid-air or in hard-to-reach areas.

This capability has promises to have broad applications in industries such as infrastructure maintenance. For example, aerial manipulators can be used to inspect and repair power lines. By enabling precise, dynamic manipulation in three-dimensional space, aerial manipulation represents a major step forward in the automation of tasks that would be dangerous or difficult for humans to accomplish.

State-of-the-art:

The state-of-the-art in aerial manipulation is exemplified by Voliro or Skygauge, whose omnidirectional drones integrates tiltable rotors with a static arm, allowing for precise and versatile touch inspections of surfaces at various angles.

Despite advancements, current aerial manipulators face limitations in payload capacity, stability during manipulation, and precision, restricting their use to low force exerting, controlled tasks in compliant environments. Also, most aerial manipulators are dependent on off-board computing and sensing. Aerial drilling is currently a very immature technology.

Voliro Drone, Morten Pedersen

AI generated image

Approach:

To showcase the potential of aerial manipulation for drilling in a set of novel use-cases, aerial manipulators will be custom built. Two specific use-cases will be explored downwards drilling and horizontal. As downwards drilling is a novel field an aerial manipulator architecture will be built from scratch. For the more mature field of horizontal drilling, existing platforms will be iterated upon with a focus on faster electronics and more efficient computation boards and sensor.

For testing a new indoor test setup for aerial manipulation at SDU will be built and utilized.

Contribution:

This thesis aims to further aerial manipulation on the specific applications of aerial drilling for infrastructure maintenance. Herein, building the first aerial manipulator which can drill downwards. Additionally, making improvements to horizontally drilling aerial manipulators.

On the technical side, faster electronics will be implemented along with computation boards to improve the onboard computing capabilities of UAS. Lastly, different sensor packages and ways of marking points of interest, such as drilling locations, will be explored.