Abstract

Wind energy is an effective low-cost and clean energy resource. To ensure further advancement and optimisation of wind turbines, there is a requirement for the development of structural health monitoring systems so that preventative and protective maintenance can be carried out. Typically access to wind turbine blades is very difficult and requires an industrial climber or a crane. This process can be very dangerous and increases the maintenance cost and risks associated with wind turbines. During the inspection process there is also a disruption in energy production as there is a requirement to shut down the wind turbine for inspection.

Drones have been used for inspection purposes and structural health monitoring tasks for many years now. This research looks at modelling the flight characteristics required to enable a drone to visually inspect the blades of a wind turbine and land on a moving surface. This will enable imagery and additional information to be collected from the blade of the turbine without requiring the turbine to be switched off. It will also remove the need for constant hovering by the drone which will optimise the battery life.

To achieve this, there is a requirement to develop an autonomous system which enables a drone to perform surveillance such as identification, recognition and tracking of a moving target. In this research, autonomous control is established over the Dagu robot, where the buggy can search, identify, and approach a target. The Dagu robot is used to simulate and model the control of a drone to increase the reliability of the system design. Computer vision methods to reliably track a moving target are investigated and tested to identify a robust, reliable algorithm. A Convolutional Neural Network is developed with a validation accuracy of 96.92% when tracking moving model cars in the horizontal plane.

This research has the potential to make major contribution to the expanding field of wind energy, by improving monitoring methods which will help support the early detection of faults, resulting in a reduction in the requirement for unscheduled maintenance, a reduction in wind turbine life-cycle costs and ultimately a reduction in the cost of energy.