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Cyclocopters: Drones of the future

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Cyclocopters are a new concept of drone that has recently shown success in development, garnering significant interest from leading robotic institutions and the US Army. The commercially available drones most people are familiar with are referred to as polycopters. Polycopters typically have four or six equally spaced helicopter style blades. They have a wide range of uses, from recreational to military, with drones recently being used by Risk Frontiers to analyse disaster areas after natural disasters such as volcanic lahars. Though these types of drones offer a wide variety of applications and already play a significant role in society, cyclocopters are viewed as the next stage in their evolution, with the potential ability to extensively survey during natural disasters and perform risk assessment.

The cyclocopter concept was developed about 100 years ago, however only recently have the materials and technology been available to turn this futuristic looking machine into reality. Cyclocopters can be visualised as an aerial paddleboat, having two or four cycloidal rotors (cyclorotors) (Figure 1). The rotors stir the air into vortices, creating lift, thrust and control. Each rotor has multiple (conventionally four) aerofoils, whose pitch (angle) can be adjusted in synchronisation to move the cyclocopter in any direction perpendicular to the cyclorotor. There is also a tail propeller to keep the drone level. Hence the aerodynamics can be viewed like that of an insect, imagine a dragonfly.

The cyclocopter design has several advantages. Unlike conventional drones which, like a helicopter, tilt in the direction of flight, cyclocopters remain parallel. Their engineering design also provides them with better maneuverability, forward speed, and altitude limit, as well as making them less disturbed by wind gusts. They are also much quieter, having lower blade-tip speeds which are responsible for the typical noise from bladed aircraft. However, the most significant advantage is that these drones actually perform better when scaled down. The vortex created by the cyclorotor configuration get proportionally more powerful as the size shrinks. This makes cyclocopters the

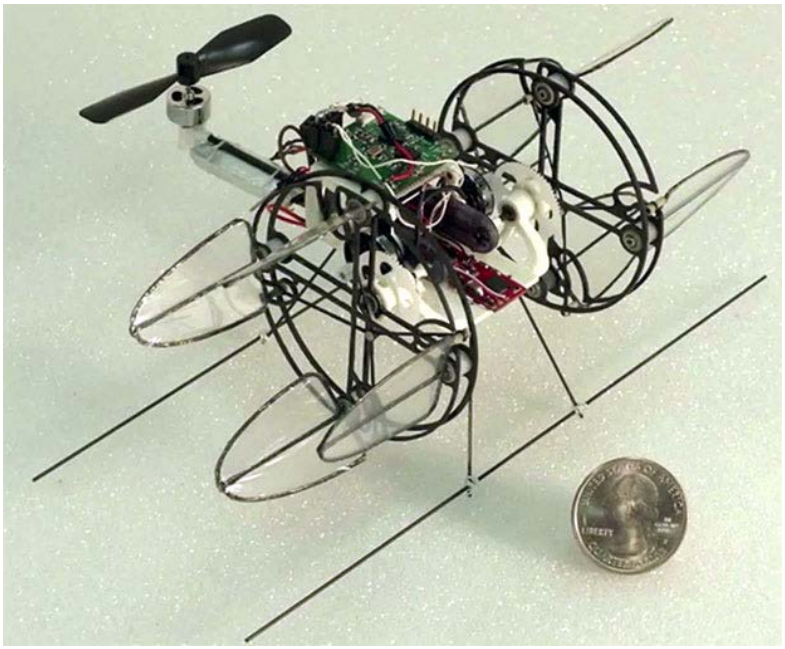

Figure 1: The world smallest functional cyclocopter. Image: Moble Benedict/Texas A&M University.

leading candidate for miniaturised drones, with the ability to withstand strong winds during natural disasters and survey inaccessible areas.

Research into cyclocopters in the USA is being carried out at the University of Maryland, Texas A&M University and the University of California, Berkley, formally as part of the Micro Autonomous Systems and Technology (MAST) programme funded by the US Army, and now under the Distributed and Collaborative Intelligent Systems and Technology (DCIST) programme. Over the last 10 years, they have developed fully functional cyclocopters whilst reducing the size and weight from 500 g to just 29 g. A video of the MAST research groups' latest cyclocopter can be found here (https://youtu.be/WTUCCkTcIWo). The next step in their evolution involves further miniaturisation and optimisation, and also getting drones to swarm and coordinate together.

Commercial cyclocopters are viewed to be only a couple of years away. They could play a significant part in saving lives. A common concept is the formation of an advanced network of drones with different capabilities. In search and rescue operations during natural disasters, cyclocopters could quickly scour the disaster area, including inaccessible areas, alerting authorities or communicating with larger ambulance drones which could provide survivors with necessities or even airlift them to safety. During gusty bushfires, a network of stabile cyclocopters could detect ignition points or homes at risk, communicating with larger extinguishing drones.

For cyclocopters individually, the military application presented by the MAST research group also focuses on saving lives, with the initiative of drones being able to fly ahead of military troops looking over ridges and embankments ensuring the soldiers safety. For the insurance industry, they could be used for the rapid assessment of unsafe and contaminated premises. From a perils standpoint, tiny cyclocopters could be used to access obstructed areas, and their stability and coordination would allow for faster and more accurate mapping of disaster relief areas, providing invaluable information for modelling.