

Don't fear the dawn of the drones—Someday one might save your life (w/ Video)

January 15 2014, by Tom Robinette



University of Cincinnati student Wei Wei makes adjustments to a UAV. Credit: Tom Robinette, University of Cincinnati

In the not too distant future, you may hear the hum of a drone's rotors as it descends upon you and be filled with a sense of relief, not panic. After all, it's coming to save you, not harm you.

Research at the University of Cincinnati could soon enable [unmanned aerial vehicles](#) (UAV) – similar to U.S. military drones patrolling the skies of Afghanistan – to track down missing persons on search-and-

rescue missions, to penetrate curtains of smoke during wildfire suppression or possibly even to navigate urban landscapes on delivery runs for online retailers like Amazon. And it all could be done autonomously with a human acting only as a supervisor.

"Drones have gotten a very bad rap for various reasons," says Kelly Cohen, associate professor of aerospace engineering and engineering mechanics at UC. "But our students see that unmanned systems can have a positive impact on society."

Cohen and a team of researchers have developed an experimental capability to capture the dynamic behavior of the UAV platform, which complements other work they've done with UAVs in disaster management operations. Wei Wei, one of Cohen's students and the lead author of "Frequency-Domain System Identification and Simulation of a Quadrotor Controller," will present the UAV dynamics research Jan. 16 at the American Institute of Aeronautics and Astronautics' SciTech 2014 conference in National Harbor, Md. The event unites international aerospace scholars and professionals to collaborate on advances in research, development and technology.

In his research, Wei used special engineering software to develop the dynamic model essential for autopilot design for a wide variety of unmanned aircraft having multiple rotors. He's applied his method to quadrotors – UAVs with four propellers – and other types of drones, but it can work with nearly any aircraft.

Plus, Cohen says there is nothing on the market today like Wei's system because of its low cost and fast, highly accurate results. Cincinnati-based entrepreneur Steve Burns is already working with UC on a concept vehicle using Wei's simulations, through a recent University of Cincinnati Research Institute (UCRI) contract.

"A selling point for this configuration is its efficiency, in both time and money, and the accuracy," Wei says. "We're already proving it using flight-test data, and it has matched nearly perfectly. This would enable not only quadrotors, but any flying objects to operate on autopilot."

First responders see advantages to drones

Wei's research overlaps with work on the Surveillance for Intelligent Emergency Response Robotic Aircraft (SIERRA) project out of UC's College of Engineering and Applied Science. SIERRA integrates UAVs outfitted with global positioning systems, environmental data, video and fire-prediction software to give real-time information to firefighters about where a fire is burning and where it is moving – information that could save lives.



University of Cincinnati student Wei Wei controls an unmanned aerial vehicle during a test burn. Credit: Photo provided by Kelly Cohen, University of Cincinnati

UC's SIERRA team, partnering with the University of Toledo team led by associate professor Manish Kumar, has tested the system on a controlled fire in collaboration with the West Virginia Division of Forestry. Rodger Ozburn, a regional fire specialist with the West Virginia Division of Forestry, has been working with the SIERRA team. He says the eye-in-the-sky perspective of a UAV combined with UC's fire-prediction technology could provide first responders a major time- and money-saving advantage.

"So many times after a natural disaster, the West Virginia Division of Forestry is the first agency called to aid in determination of damage or loss, and having UAV technology at our fingertips will be an extreme asset, compared to high-cost aerial flights with a helicopter or airplane," Ozburn says. "We would be able to obtain quick, low-cost images and video footage of damaged areas, and would be able to transfer that information to other agencies in minutes, rather than hours or days."

The Cincinnati Fire Department (CFD) is also interested in UC's UAV research. Bryan Brown, leader of the SIERRA team and a student of Cohen's, has been working with CFD District Fire Chief Tom Lakamp to determine opportunities where a UAV could be helpful on an emergency scene.



UC student Bryan Brown displays a quadrotor UAV. Credit: Tom Robinette, University of Cincinnati

Brown and Lakamp are planning a joint SIERRA-CFD search-and-rescue drill this spring. Typically, search-and-rescue missions require firefighters to scour broad swaths of difficult terrain on foot while encumbered with heavy gear and visually impaired by smoke or darkness. But those challenges don't exist for drones.

"With a UAV, you don't have to worry about terrain or time of day," says Brown, noting a UAV can be equipped with a thermal camera. "You just go and find what you're looking for."

The research by Cohen, Wei, Brown, UC Fire Science & Emergency Management Program Chair Lawrence Bennett and the SIERRA team supports the UC2019 Academic Master Plan by producing new ways of understanding and transforming the world through research and scholarship. The team's collaborations with the West Virginia Division of Forestry and the Cincinnati Fire Department are also Cincinnati

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For now, Federal Aviation Administration regulations greatly limit the use of drones. Cohen predicts that in the next few years FAA guidelines will adapt to this technology, and he believes disaster management and public safety officials such as firefighters and police will be among the first to be licensed to operate drones in national airspace.

Meanwhile, state Rep. Rick Perales is promoting a bill in the Ohio legislature that would help make the Buckeye State a leading hub of UAV research and development. In addition to federal and state government interest in UAVs, Cohen anticipates a surge in commercial involvement too. He says UC is uniquely positioned to capitalize on all the attention surrounding the burgeoning industry.

"We are playing to our strengths: UAV operations and cooperative control for multi-UAV operations; system identification; autopilot design; and the desire to make a difference with first responders. That will set us apart. We will have a unique identity," Cohen says. "We don't want to be just another player in the world of UAVs. We want to have our specific niche, and we want to be the best in the world in that niche."

Contributors to Wei's research are Mark Tischler, senior scientist and flight control group lead for the Aeroflightdynamics Directorate of the U.S. Army Research, Development and Engineering Command; Cohen; and UC engineering student Nicholas Schwartz. Additional support was provided by Burns through UCRI.

Some support for the SIERRA project was provided by NASA through the Ohio Space Grant Consortium with the University of Cincinnati providing more than 50 percent of the cost share. Further research

contributions were provided by UC's Bennett and the University of Toledo's Kumar.

More information: www.aiaa.org/scitech2014/

Provided by University of Cincinnati

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