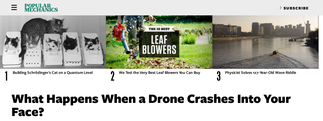

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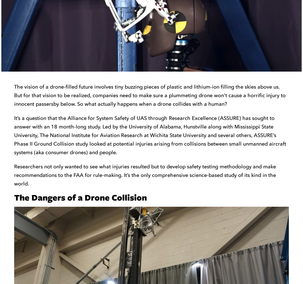
What Happens When a Drone Crashes Into Your Face?

An 18-month-long study attempts to find out.

By Eric Taylor Aug 23, 2019

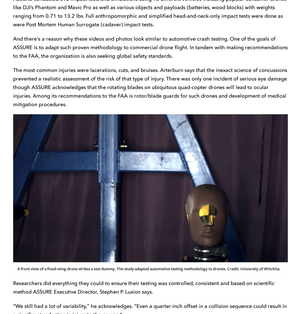


The vision of a drone-filled future involves tiny buzzing pieces of plastic and lithium-ion filling the skies above us. But for that vision to be realized, engineers have to make sure a plummeting drone won't cause a horrific injury to innocent passersby below. So what actually happens when a drone collides with a human?

It's a question that the Alliance for System Safety of UAS through Research Excellence (ASSURE) has sought to answer with an 18 month-long study. Led by the University of Alabama, Huntsville along with Mississippi State University, The National Institute for Aviation Research at Wichita State University and several others, ASSURE's Phase II Ground Collision study looked at potential injuries arising from collisions between small unmanned aircraft systems (aka consumer drones) and people.

Researchers not only wanted to see what injuries resulted but to develop safety testing methodology and make recommendations to the FAA for rule-making. It's the only comprehensive science-based study of its kind in the world.

The Dangers of a Drone Collision



The testing setup for the drone collision experiment.
WICHITA STATE UNIVERSITY

It sounds potentially terrifying and the videos here don't look reassuring but ASSURE found that the small, mostly plastic drones are very flexible with a lot of elasticity. Contrary to popular opinion, they tend to absorb a significant amount of energy, says David Arterburn, ASSURE's principal investigator.

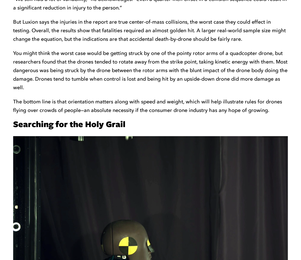
"A common misconception is that every drone is a rock so when it hits you, it's going to hurt you like a rock."

> "BOTH CONSTRUCTION AND MASS HAVE A ROLE IN DEFINING INJURY POTENTIAL."

ASSURE conducted 512 impact tests and simulations using 16 different vehicles including popular consumer drones like DJI's Phantom and Mavic Pro as well as various objects and payloads (batteries, wood blocks) with weights ranging from 0.71 to 13.2 lbs. Full anthropomorphic and simplified head-and-neck-only impact tests were done as were Post Mortem Human Surrogate (cadaver) impact tests.

And there's a reason why these videos and photos look similar to automotive crash testing. One of the goals of ASSURE is to adapt such proven methodology to commercial drone flight. In tandem with making recommendations to the FAA, the organization is also seeking global safety standards.

The most common injuries were lacerations, cuts, and bruises. Arterburn says that the inexact science of concussions prevented a realistic assessment of the risk of that type of injury. There was only one incident of serious eye damage though ASSURE acknowledges that the rotating blades on ubiquitous quad-copter drones will lead to ocular injuries. Among its recommendations to the FAA is rotor/blade guards for such drones and development of medical mitigation procedures.



A front view of a fixed-wing drone strikes a test dummy. The study adopted automotive testing methodology to drones. Credit: University of Wichita.

Researchers did everything they could to ensure their testing was controlled, consistent and based on scientific method ASSURE Executive Director, Stephen P. Luxion says.

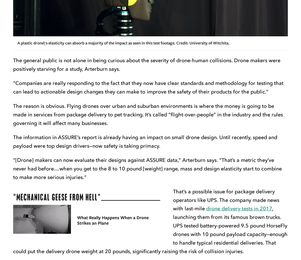
"We still had a lot of variability," he acknowledges. "Even a quarter-inch offset in a collision sequence could result in a significant reduction in injury to the person."

But Luxion says the injuries in the report are true center-of-mass collisions, the worst case they could effect in testing. Overall, the results show that fatalities required an almost golden hit. A larger real-world sample size might change the equation, but the indications are that accidental death-by-drone should be fairly rare.

You might think the worst case would be getting struck by one of the pointy rotor arms of a quadcopter drone, but researchers found that the drones tended to rotate away from the strike point, taking kinetic energy with them. Most dangerous was being struck by the drone between the rotor arms with the blunt impact of the drone body doing the damage. Drones tend to tumble when control is lost and being hit by an upside-down drone did more damage as well.

The bottom line is that orientation matters along with speed and weight, which will help illustrate rules for drones flying over crowds of people–an absolute necessity if the consumer drone industry has any hope of growing.

Searching for the Holy Grail



A plastic drone's elasticity can absorb a majority of the impact as seen in this test footage. Credit: University of Wichita.

The general public is not alone in being curious about the severity of drone-human collisions. Drone makers were positively starving for a study, Arterburn says.

"Companies are really responding to the fact that they now have clear standards and methodology for testing that can lead to actionable design changes they can make to improve the safety of their products for the public."

The reason is obvious. Flying drones over urban and suburban environments is where the money is going to be made in services from package delivery to pet tracking. It's called "flight-over-people" in the industry and the rules governing it will affect many businesses.

The information in ASSURE's report is already having an impact on small drone design. Until recently, speed and payload were top design drivers–now safety is taking primacy.

"[Drone] makers can now evaluate their designs against ASSURE data," Arterburn says. "That's a metric they've never had before…when you get to the 8 to 10 pound [weight] range, mass and design elasticity start to combine to make more serious injuries."

"MECHANICAL GEESE FROM HELL"

What Really Happens When a Drone Strikes an Plane

That's a possible issue for package delivery operators like UPS. The company made news with last-mile drone delivery tests in 2017, launching them from its famous brown trucks. UPS-tested battery-powered 9.5 pound Horsefly drones with 10 pound payload capacity–enough to handle typical residential deliveries. That could put the delivery drone weight at 20 pounds, significantly raising the risk of collision injuries.

One of the key findings of ASSURE's testing was that drone payloads tend to have stiffer construction and more mass, increasing injury potential.

"Many payloads do not have the elasticity that the vehicles have because of their construction," Arterburn says. "Both construction and mass have a role in defining injury potential." For example, a half-pound lithium battery poses more risk when carried externally than when enclosed within a 2.5 pound drone.

Regulations governing the kind of payloads, weights, and configurations that delivery drones can carry seem very likely. The potential use of drone parachutes may reduce risk but a lot more testing in less controlled conditions will be needed.

For now, unrestricted drone flight-over-people remains a dream–but it's a dream worth chasing.

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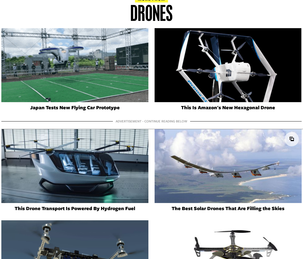

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