The University of Texas at Austin
Environmental Science Institute

Hot Science - Cool Talk # 93

Drones: Myths, Facts, Hacks, and the Future

Dr. Todd Humphreys
November 21, 2014

THE UNIVERSITY OF TEXAS AT AUSTIN
RADIONAVIGATION LABORATORY

Drones: Myths, Facts, Hacks, and the Future

Todd Humphreys | Aerospace Engineering
The University of Texas at Austin

Nov. 21, 2014


LONGHORNS
TEXAS

Alcalde

NOVEMBER | DECEMBER 2014

It's TRUE, they're here ... UNMANNED aerial vehicles!

In your own BACKYARD!

"The Drones"

PAGE 46

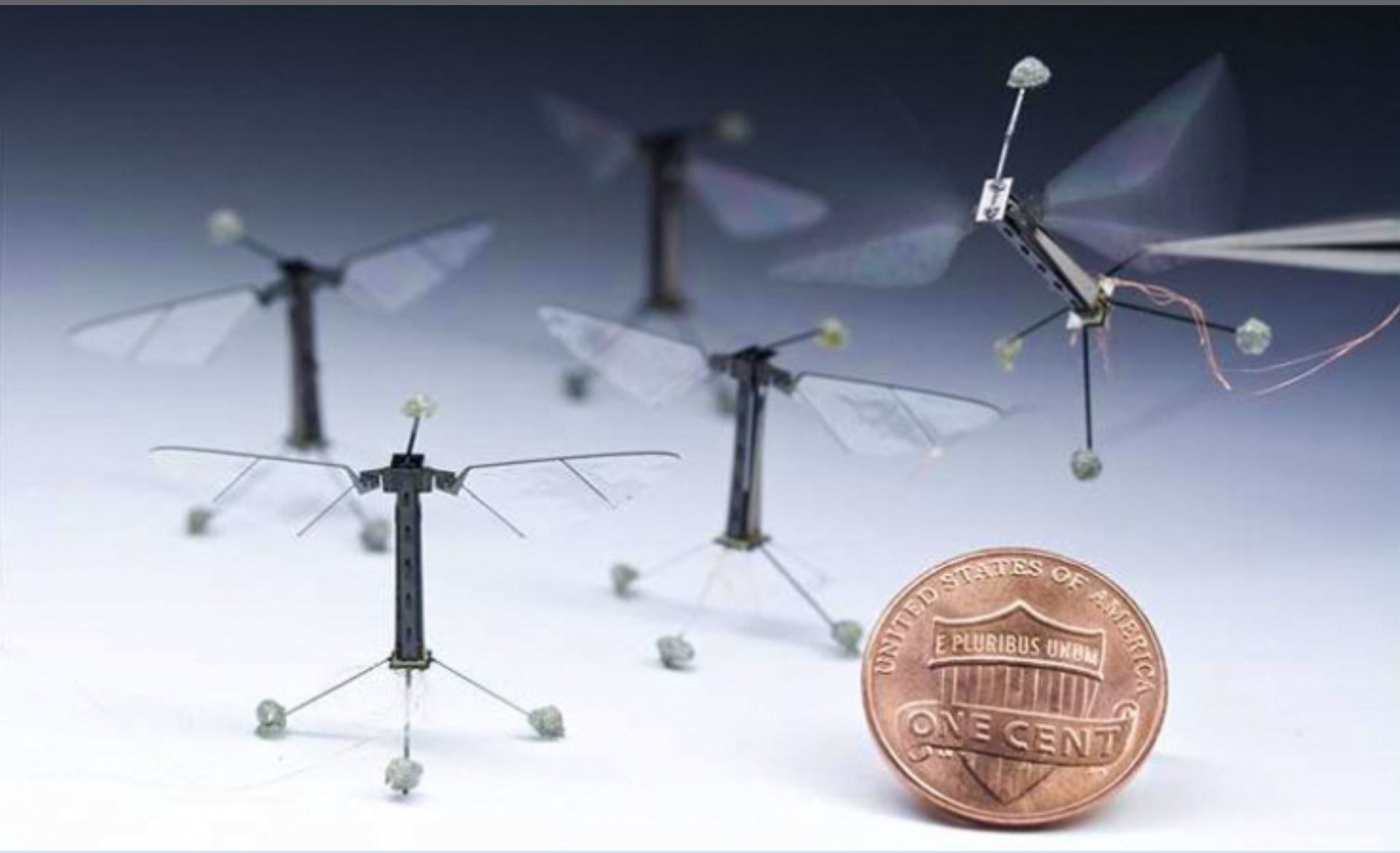
Our lives will never be the same!

Drones are Here!

Our lives will never be the same!

Drones are Here!
Our lives will never be the same!

What are drones?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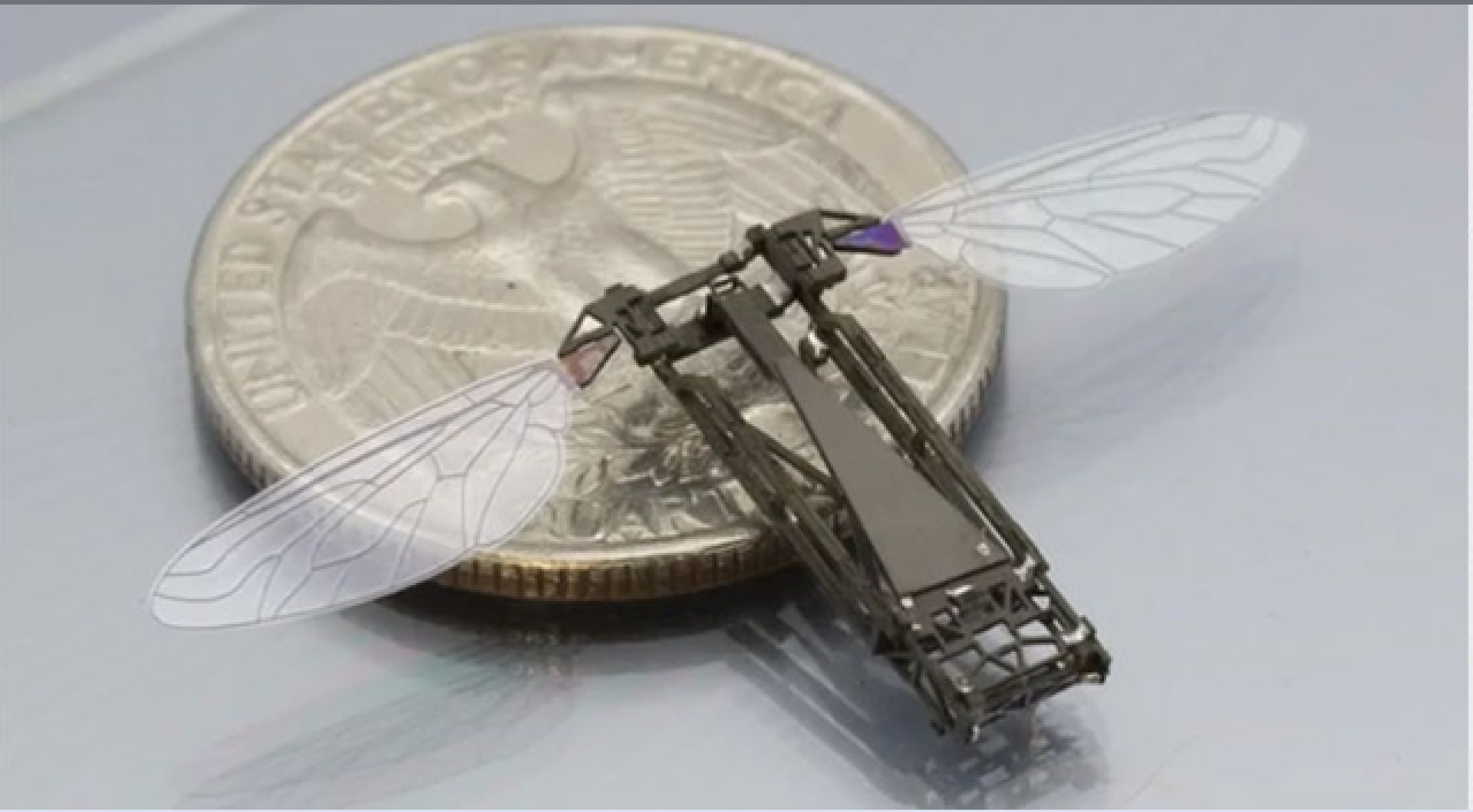
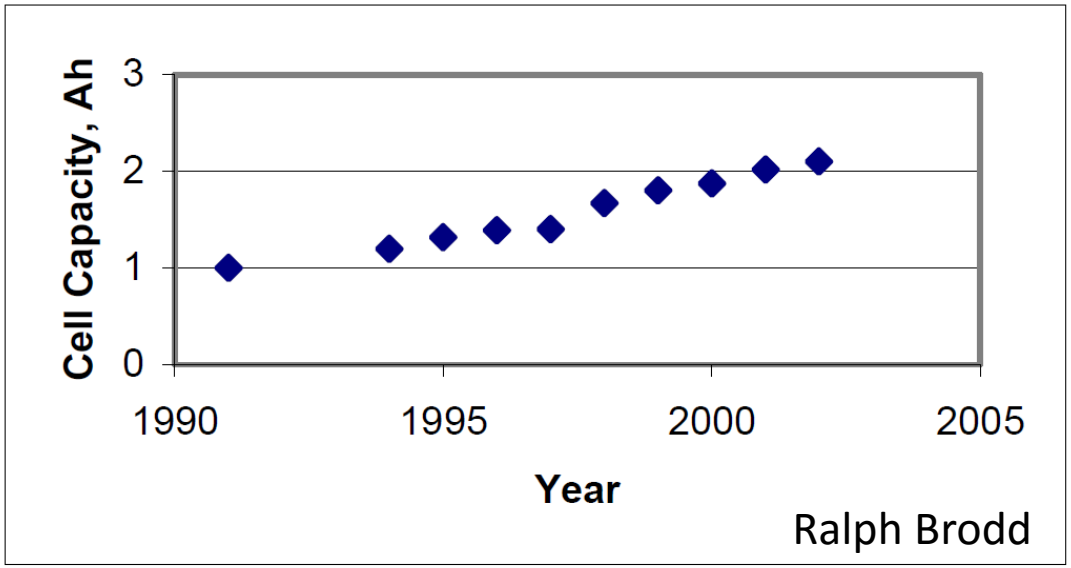

UNITED STATES OF AMERICA
QUARTER

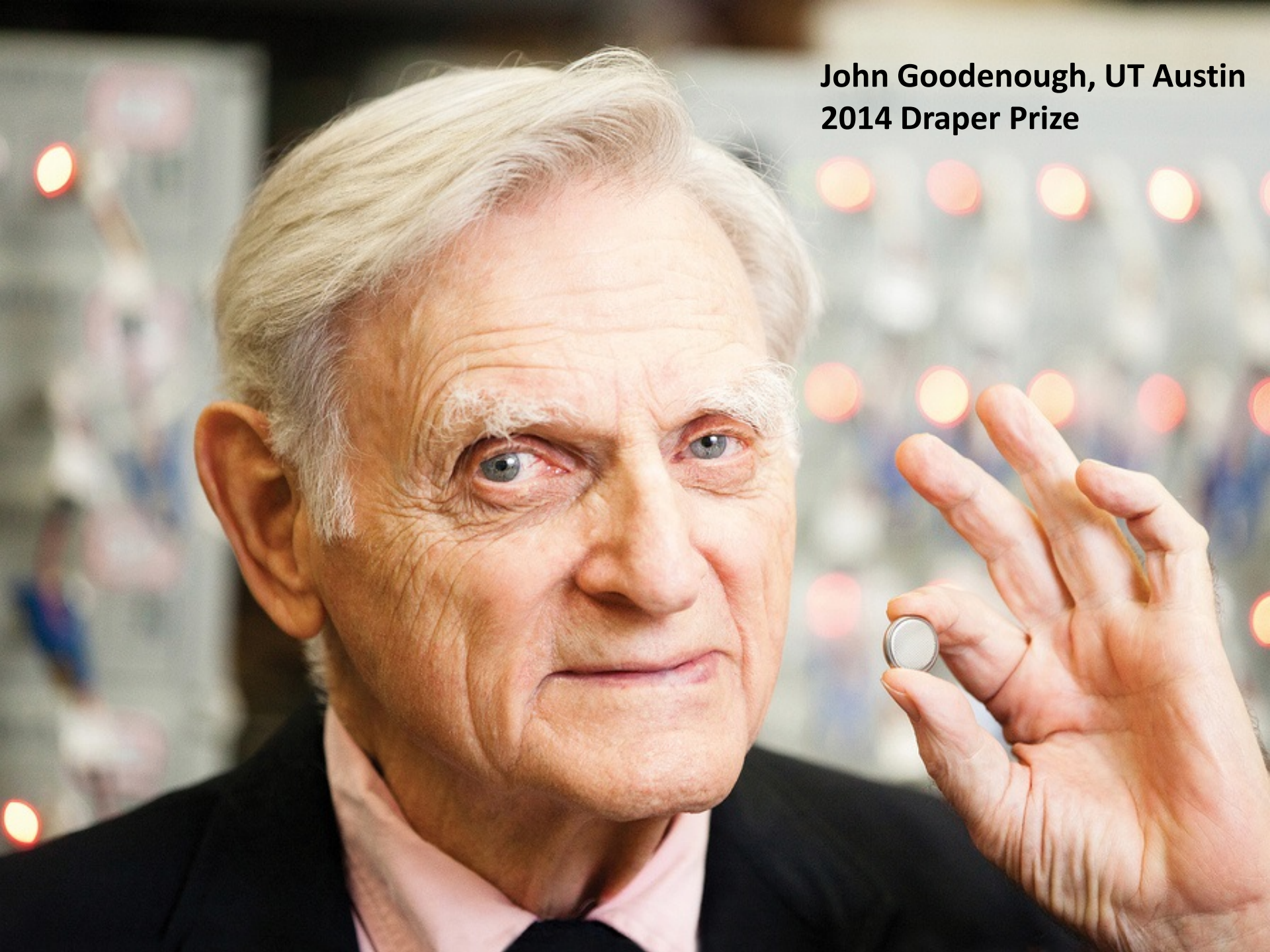
Lithium Ion Batteries

Commercialized in 1991

Twice the energy density and smaller than NiCd or NiMH

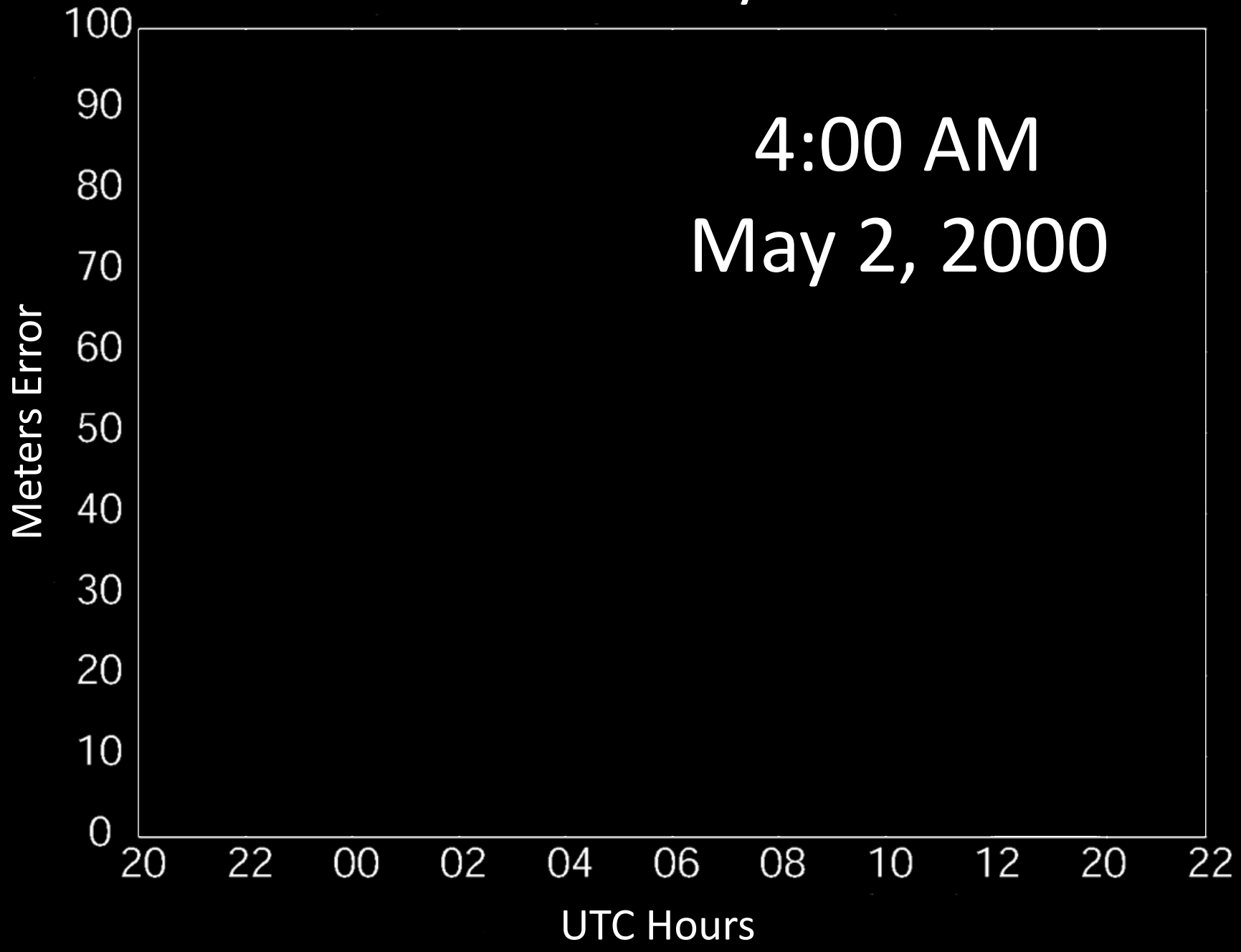
Lithium Ion Batteries




John Goodenough, UT Austin
2014 Draper Prize

Small, Low-Cost, High-Performance Computation

GPS "Selective Availability" Switched Off



Low-Cost, High-Resolution Digital Cameras

Drone

Unmanned Aerial Vehicle (UAV)

Remotely Piloted Aircraft

Aeronaves pilotadas por control remoto

Unmanned Aerial System (UAS)

Autonomous Aircraft

Is it legal to fly a drone?

SERVED: November 18, 2014

NTSB Order No. EA-5730

Adopted by the NATIONAL TRANSPORTATION SAFETY BOARD
at its office in Washington, D.C.
on the 17th day of November, 2014

MICHAEL P. HUERTA, Administrator, Federal Aviation Administration, Complainant, v. RAPHAEL PIRKER,	)	Docket CP-217

"An aircraft is any device used for flight in the air. This definition includes any aircraft, large or small. The prohibition on careless and reckless operation in 91.13(a) applies with respect to any aircraft other than [kites and balloons]."

The Rub:

The FAA considers flying an aircraft below 500 feet reckless (except at takeoff and landing)

But ...

FAA guidance on model aircraft: “Don’t fly above 400 feet.”

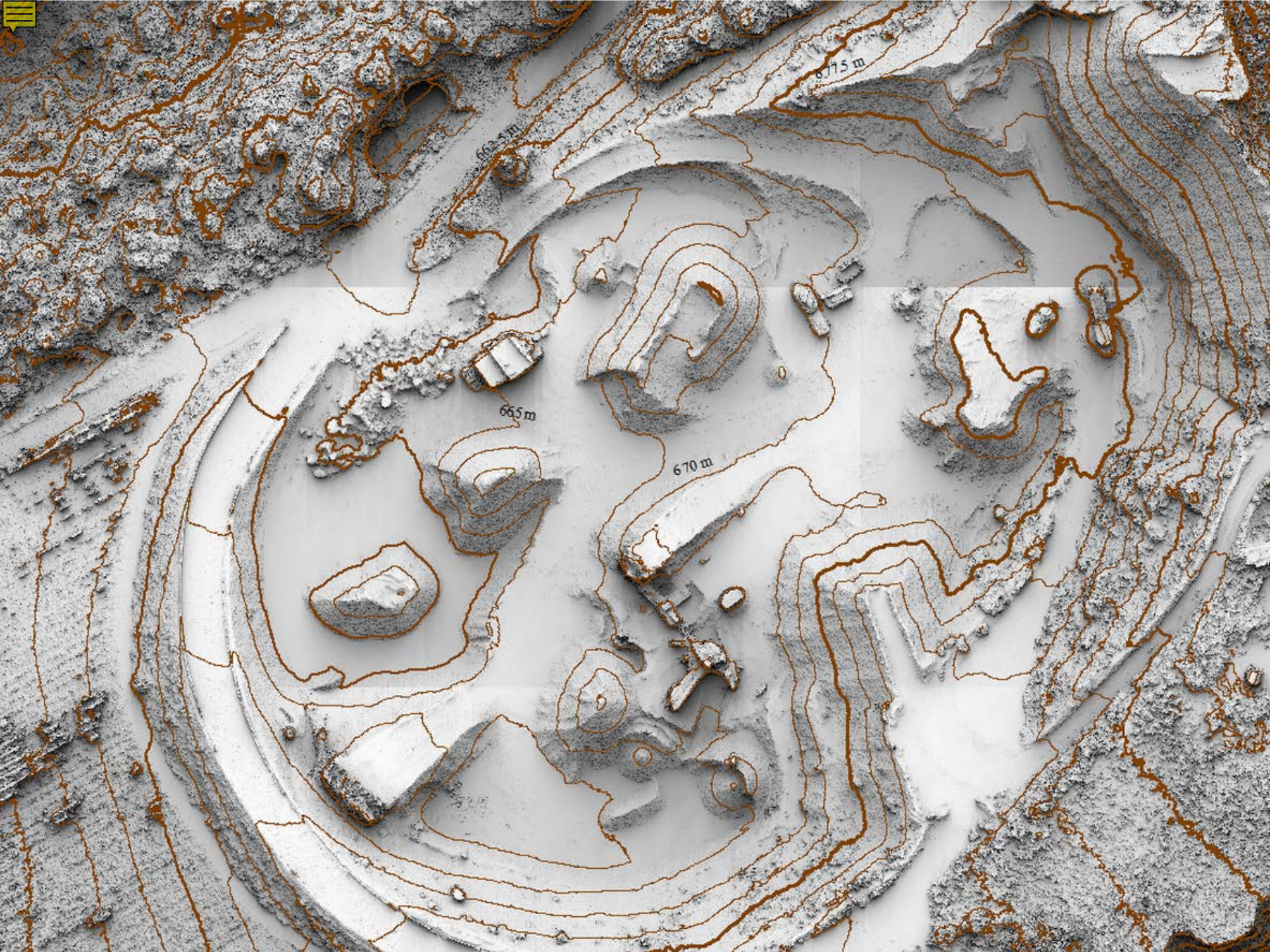
So ... federal regulations on drones are currently both ***absurd*** and ***inconsistent***

Texas Law (HB 912): Need neighbor’s consent to capture image by drone of him on his property

My advice:

1. Don’t fly near airports
2. Stay under 400 feet
3. Don’t fly for hire
4. No close-up pictures of people without consent
5. Don’t scare people

What would I do with a drone?


662.5 m
665 m
670 m
675 m


md4-1000
DHL
M
PACKSET

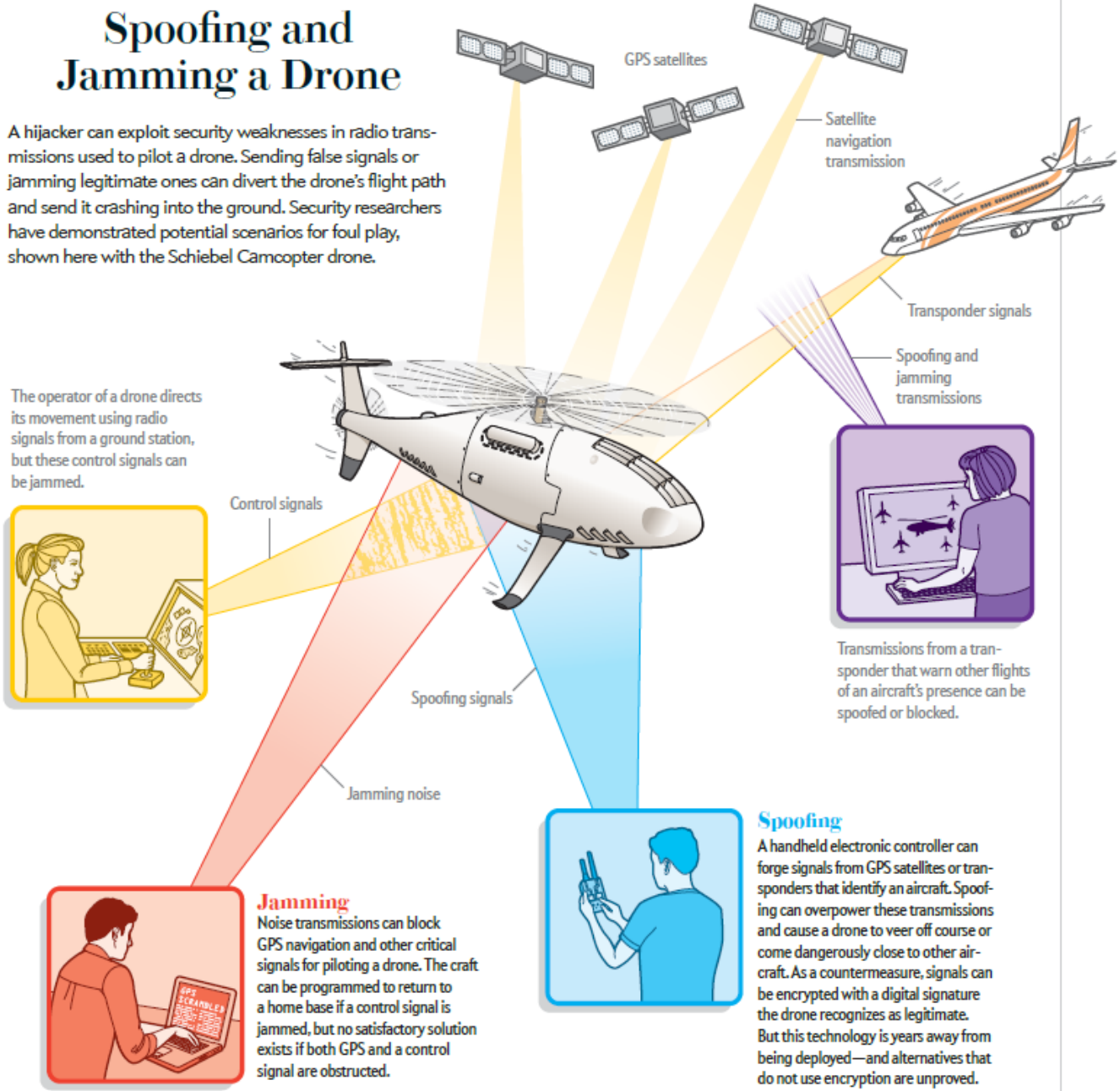
Can drones be hacked?

Missing CIA RQ-170 Sentinel Stealth Drone December 4, 2011


آمریکا هیچ غلطی نمی تواند بکند
امام خمینی (ره)
الله اکبر
مرگ بر آمریکا
مرگ بر اسرائیل
مرگ بر انگلیس
امام خمینی (ره):
آمریکا هیچ

Spoofing and Jamming a Drone

A hijacker can exploit security weaknesses in radio transmissions used to pilot a drone. Sending false signals or jamming legitimate ones can divert the drone's flight path and send it crashing into the ground. Security researchers have demonstrated potential scenarios for foul play, shown here with the Schiebel Camcopter drone.



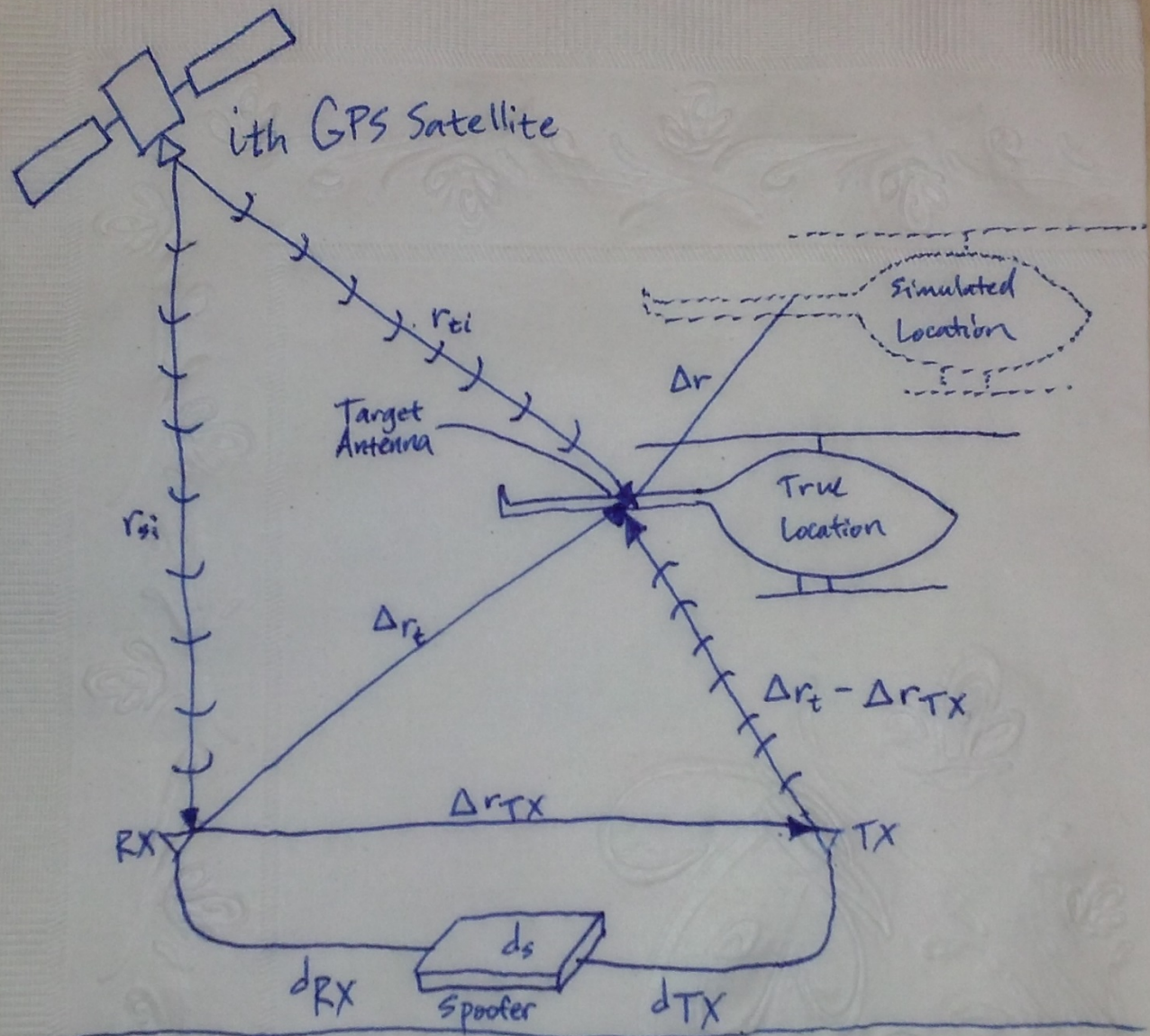
Jamming

Noise transmissions can block GPS navigation and other critical signals for piloting a drone. The craft can be programmed to return to a home base if a control signal is jammed, but no satisfactory solution exists if both GPS and a control signal are obstructed.

Spoofing

A handheld electronic controller can forge signals from GPS satellites or transponders that identify an aircraft. Spoofing can overpower these transmissions and cause a drone to veer off course or come dangerously close to other aircraft. As a countermeasure, signals can be encrypted with a digital signature the drone recognizes as legitimate. But this technology is years away from being deployed—and alternatives that do not use encryption are unproved.

Wesson and Humphreys, Scientific American, Nov. 2013



$$c d_i = r_{si} - r_{ti} + c\left(d_{RX} + d_{TX} + d_s\right) + \|\Delta r_t - \Delta r_{TX}\|$$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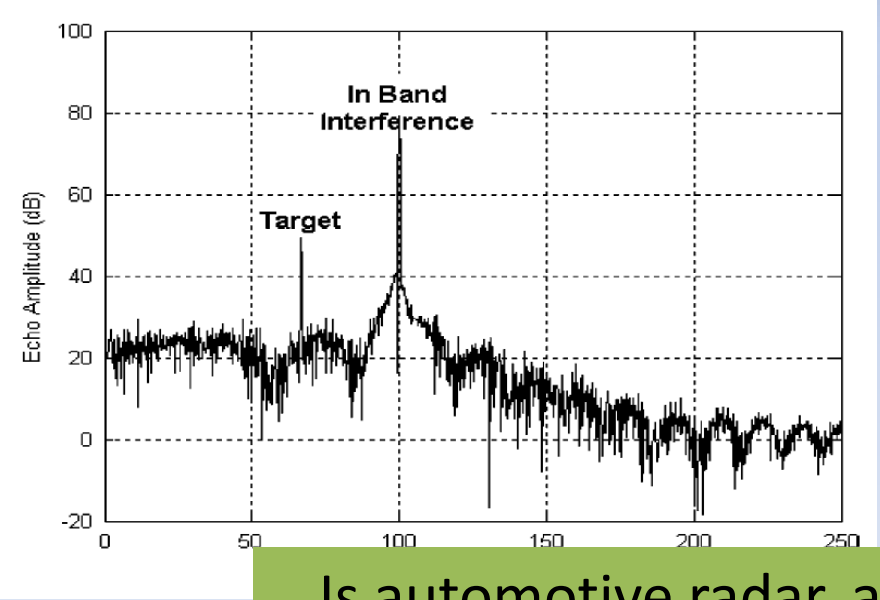
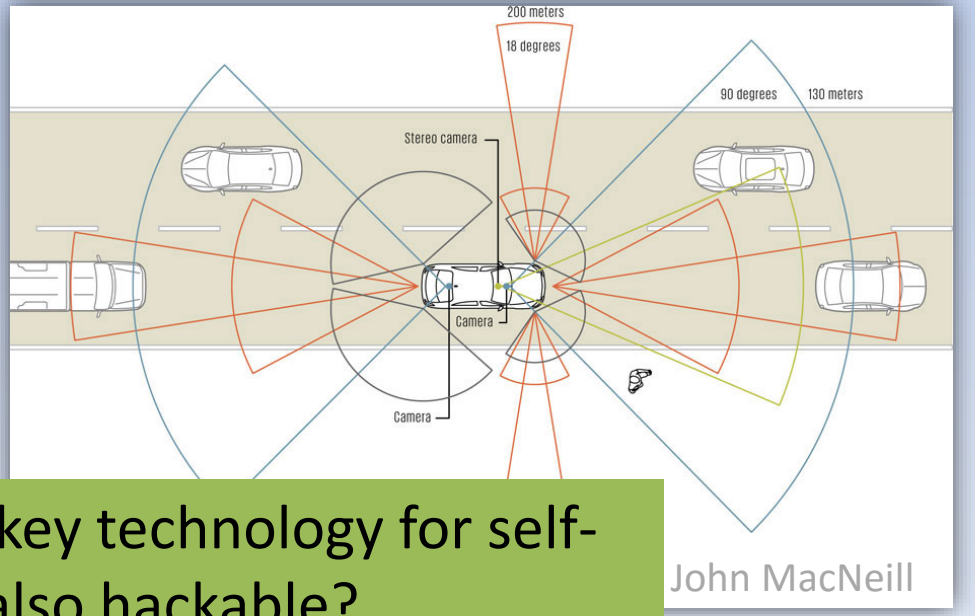
Easier to Crash than to Control


WHITE ROSE OF DRACHS

Photo: Daimler



Booker, "Mutu
systems." (200



John MacNeill

Is automotive radar, a key technology for self-driving cars, also hackable?

Do drones like to play sports?


CDW
Nestlé
Pure Life
EARN REWARDS
14


TEXAS
ORNS
TEXAS


LONGHORNS
Darrell K Royal - Texas
Throttle: 030.3 %
Max Angle: 15.0 [deg]
HDG: 275 [deg]
Velocity Controller Gains
Horizontal PID Gains
Altitude PID Gains
Actions
Run ML
Reset ML
Download
Standby
DELL

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radionavlab.ae.utexas.edu

Dr. Todd Humphreys

Todd Humphreys directs the Radionavigation Laboratory at UT Austin, where advanced radionavigation technology is being developed, and novel ways to exploit and protect radionavigation systems such as GPS are being explored.

Dr. Humphreys has Ph.D. from Cornell University. He received the UT Regents' Outstanding Teaching Award in 2012, the NSF CAREER Award in 2015, and the Institute of Navigation Thurlow Award in 2015. Dr. Humphreys joined the faculty of the Cockrell School of Engineering in Fall 2009.