Unmanned Aerial Vehicle (UAV) Research at WSU

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Things that fly in the Sky: A Hierarchy of Drones

Nano Quad Drone
- Rotor span 1.8 inches
- Smallest consumer available drone, range 150 feet

Proxdynamics Black Hornet
- Rotor span 4.6 inches
- Currently used by British forces in Afghanistan

Aerovironment Black Widow
- Wing Span 6 inches
- First operating microdrone, built in 1998

WSU BSE Copter
- Span 28 inches
- German built used to test agriculture sensors

Insitu ScanEagle
- Wing Span 10.2 feet
- Surveillance drone built in Bingen, WA

Yamaha RMAX
- Rotor Span 12 feet
- Crop Sprayer since 1998

WSU HYPER Lab GENII
- Wing Span 18.2 feet
- Designed and built for hydrogen fuel testing

Northrup-Grumman Global Hawk
- Wing Span 116 feet
- $220 million each, combat + surveillance

General Atomics Predator B (Reaper)
- Wing Span 66 feet
- “hunter-killer” Top speed 300 mph at 50,000 feet

Boeing X-45A
- Wing Span 34 feet
- Top speed 600 mph
Performance of Energy Storage Mediums

- Thermite, Metals
- Fossil fuels, heavy hydrocarbons
- Biologicals, alcohols
- Methane
- Batteries
- Hydrogen

Goal!
WSU and Hydrogen Vehicles: Circa 2012
Liquid Hydrogen Fueled UAS

- Funded $20,000 on June 30th 2012
- Mission From Dean: Be the first university team to design, build, and fly an LH$_2$ fueled UAV.
Design - Build - Test

Geni

Design - Build - Test

Washington State University

Jacob Leachman • School of Mechanical and Materials Engineering
<table>
<thead>
<tr>
<th>Flight</th>
<th>Date</th>
<th>Duration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight 1</td>
<td>5/18/2013</td>
<td>16 min</td>
<td>First Flight</td>
</tr>
<tr>
<td>Flight 2</td>
<td>5/31/2013</td>
<td>18 min</td>
<td>First Autonomous Operation</td>
</tr>
<tr>
<td>Flight 3</td>
<td>6/15/2013</td>
<td>32 s</td>
<td>ESC Failure, Ditch</td>
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<tr>
<td>Flight 4</td>
<td>8/10/2013</td>
<td>3.5 min</td>
<td>Dead stick Landing</td>
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<tr>
<td>Flight 5</td>
<td>9/28/2013</td>
<td>22 min</td>
<td>Cold and wet</td>
</tr>
<tr>
<td>Flights 6&amp;7</td>
<td>10/5/2013</td>
<td>46 min</td>
<td>Great Success</td>
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</tbody>
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Transferring Technology to

- Awarded $75,000 on 7/1/2014 from
- Cryogenic Type IV Hydrogen Fuel Tank for ScanEagle

Liquid hydrogen production + Patent pending storage system + PEM fuel cell powerplant = New capabilities and markets
Opening new possibilities

- WCTA “Golden Age for Agriculture”
- Birds damage $78 million/year of fruit in WA State!
- Funding from Blueberry Commission
- Working with WSU-CPAAS
UAS Machine Learning/Autonomy

- NSF CAREER Award: A Multiagent Teacher/Student Framework for Sequential Decision Making Tasks
- Robust Autonomous Robot Control Under Uncertainty
- Multi-robot coordination

Dr. Matthew Taylor
Assistant Professor
Allred Distinguished Chair
Computer Science
Thank you.

Hydrogen properties for energy research.