Lone Star UAS Center of Excellence and Innovation (LSUASC)

www.lsuasc.tamucc.edu
The LSUASC Assisting Texas With UAS Operations (A Great Year!)
Public Service Announcement

Pay Attention or

YOU’RE FIRED !!!!
Everything starts with a Safety Brief
(In Case of Emergency)

- First Aid Officer / CPR – Tom Frierson
- Emergency Medical – Call 911
- Evacuation Process – Out the door to right and main entrance, rally at parking garage
- University Police Department  
  (361) 825-4444
- Officers are on Duty with us today and we thank the UPD Chief of Police Alan Gutierrez for their support!
Agenda

- Welcome & Introductions
- Innovations & Research Successes
- UAS Vision for Texas
- UAS Panel of Experts Remarks
- UAS Audience Questions & Remarks
- The Way Forward

Goals

- To provide a better understanding of Unmanned Aircraft Systems (UAS)
- To discuss UAS related research and opportunities

Challenge

- Technology explosion
- Differences in UAS requirements
- Alternative interpretations
- Community education
The FAA UAS Test Site Competition (Selected by FAA December 2013)

25 Applicants from 24 States
(This does not reflect team members)
First LSUASC Test Site Flight June 2014

First Flight by Wright Brothers
Kitty Hawk, NC
17 Dec 1903

First Flight by TAMUCC/LSUASC
Padre Range, Sarita, TX
24 June 2014

Kitty Hawk Moments
“the moment when the impossible becomes reality”
Test Site Purpose

Stand Up And Operate A FAA UAS Test Site Designated To Safely Integrate Public And Civil UAS Operations Into The National Airspace

Provide FAA R&D And Operational Data To Facilitate The Development Of Procedures, Standards And Regulations For Safe UAS Operations

Serve As The Engine For Economic Development On Behalf Of The Governor And The State Of Texas
A Test Site Safety Readiness Survey Team from the FAA performed an Onsite Readiness Survey Of The Six UAS Test Sites

- Organization
- Planning
- Policies And Procedures
- Safety
- Security

Created And Implemented >90 Approved Policies, Processes & Plans

“Exceptional Business Development Approaches, Processes And Staff."

“Thorough Standard Operating Procedures...”

“Robust Security Program Covering Physical, Data And ITAR Security.”
We Are Secure (FAA Order 1600)
Sensitive Security Information

FAA Notes: "LSUASC has a robust security program"

LSUASC Test Site

Data & Communications

Facilities

ITAR Compliant

Bringing UAS to America's Skies.....Safely & Securely
UAS Impact on Texas

• Based on a 2014 Study by the Association for Unmanned Vehicle Systems International (AUVSI):

10 Year cumulative impact in Texas over 8,000 jobs and $6.5 Billion!!!
### LSUASC Research Accomplishments

**Mission Data (as of September 2015)**

<table>
<thead>
<tr>
<th>RANGE/FLIGHT HOURS</th>
<th>TOTAL FLIGHT HOURS</th>
<th>As of: 16 Sep 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SAFE HOURS</td>
<td>TTL HOURS</td>
</tr>
<tr>
<td>Range Operations</td>
<td>307</td>
<td>307</td>
</tr>
<tr>
<td>Flight Hours</td>
<td>73.2</td>
<td>73.2</td>
</tr>
<tr>
<td>Ground Station Operations</td>
<td>137.0</td>
<td>137.0</td>
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</table>

<table>
<thead>
<tr>
<th>Unplanned Operations</th>
<th>TOTAL =</th>
<th>As of: 16 Sep 2015</th>
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<tbody>
<tr>
<td>Loss of Communication</td>
<td>0</td>
<td>73.2</td>
</tr>
<tr>
<td>Lost Link Events</td>
<td>1</td>
<td>73.2</td>
</tr>
</tbody>
</table>

- NASA UAS Traffic Management (UTM) Safety Review Boards and Flights 2015-08
- Live flight data sent through LSUASC Client to NASA UTM; ground check at NASA Ames 2015-06
- Performed first night flight operation 2015-06
- Simulated real world RF environment to test CNPC for industry partner 2015-05
- Tested Ground Based Radar and Spectrum Deconfliction equipment 2015-03
Why Texas? - Texas UAS Test Ranges
(~61,000 Square Miles)
Why Texas?

First to fly under 200’ Blanket COA
(Search & Rescue Operations)

First to fly under 400’ Blanket COA
(Oil & Gas Operations)
Why Texas?

First to daisy-chain visual observers during flight
Why Texas?

- First to fly between multiple COAs (Padre and Laguna test ranges)
Why Texas?

- First to utilize situational awareness tool during flight (Symphony® RangeVue™)
- First to use ground-based detect and avoid radar (SRC Inc LSTAR®)
- First to fly a large, fixed-wing UAS (greater than 55 lbs.)
Why Texas?

First to develop an **operational** Mission Control Center (MCC)
- Fully functional test control facility
- UAS metadata and sensor collection
- Human-machine interface
Why Texas?

First to fly and send data from the MCC to NASA’s UAS Traffic Management System (UTM)

First to demonstrate UTM @ NASA Ames Research Center on August 28, 2015

The LSUASC has been awarded multiple research grants from NASA!
Texas State Agency Partners and Interest
### Flight Data Submitted to FAA

<table>
<thead>
<tr>
<th>Flight Data Submitted to FAA</th>
<th>Precision Hawk Lancaster</th>
<th>senseFly eBee</th>
<th>AirRobot 180</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmanned aircraft system/registration #</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of operation (civil or public)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airspace categorization and altitudes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flight take-off/landing times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weather data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Launch/recovery locations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flight crew qualifications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidents/accidents (if necessary)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
UAS Sensors

- **Visual (RGB)**
  - Orthomosaic

- **High – Resolution Multispectral Sensor (BGNIR)**
  - Normalized Difference Vegetation Index (NDVI)

- **Infra-Red with live video**

- **Five or Six Channel Multispectral**
  - Difference Vegetation Index (DVI)

- **UV Sensor**

- **LiDAR**

- **Daylight Camera**
  - High Resolution Still Camera
  - Zoomed in

- **Sony CX410 Camcorder**
## Ongoing UAS Research

<table>
<thead>
<tr>
<th>FAA Research Goals</th>
<th>Research Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe UAS operations in authorized airspace; data gathering and reporting for safe integration into NAS</td>
<td>TEEX Flight Operations Disaster Safety Research (2014-15)</td>
</tr>
<tr>
<td></td>
<td>LSUASC Prototype LVC Connection for Wildfire UAS Operations (2015)</td>
</tr>
<tr>
<td>Establish and report airworthiness of UAS</td>
<td>TAMUCC Wind Tunnel Instrumentation Research (2014-15)</td>
</tr>
<tr>
<td></td>
<td>TEES Intelligent Motion Video Algorithms Autonomous Soaring for UAS (2014-15)</td>
</tr>
<tr>
<td></td>
<td>TEES Autonomous Soaring for UAS (2014-15)</td>
</tr>
<tr>
<td>Address command and Control link issues for safe operations</td>
<td>Autonomous Neurocognitive Research (2014-17)</td>
</tr>
<tr>
<td></td>
<td>TAMUCC GPS/INS Integration Precision Ag Platform (2014-16)</td>
</tr>
<tr>
<td></td>
<td>TAMUCC Command and Control in Urban Areas (2015-18)</td>
</tr>
<tr>
<td></td>
<td>TEES Autonomous Take-Off and Landing (2014-15)</td>
</tr>
<tr>
<td></td>
<td>SwRI Cooperative Command and Control (2014-15)</td>
</tr>
<tr>
<td></td>
<td>LSUASC Command and Control Spectrum Deconfliction (2015)</td>
</tr>
</tbody>
</table>
# Ongoing UAS Research

<table>
<thead>
<tr>
<th>FAA Research Goals</th>
<th>Research Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct safe UAS ground and airborne sense &amp; avoid research</td>
<td>TEES ADS-B Universal Access Transceiver on a UAS (2014)</td>
</tr>
<tr>
<td></td>
<td>TAMUCC Integrated Gas Monitoring and Source ID (2015-19)</td>
</tr>
<tr>
<td></td>
<td>LSUASC GBSAA and ADS-B Laguna Range Characterization (2015)</td>
</tr>
<tr>
<td>Investigate environmental impacts of launch and recovery operations and airspace</td>
<td>TAMUCC High-resolution LiDAR Observations of Rookery Islands (2014-15)</td>
</tr>
<tr>
<td></td>
<td>TAMUCC Precision Ag NDVI from Near-IR and Red Channel Imagery (2014-16)</td>
</tr>
<tr>
<td></td>
<td>TAMUCC Usage of a Terrestrial Laser Scan for Precision Ag (2014-16)</td>
</tr>
<tr>
<td></td>
<td>TAMUCC Gulf of Mexico Gas and Fluid Advection Sites (2014-17)</td>
</tr>
<tr>
<td></td>
<td>TAMUCC Aerial Survey Techniques for Eco-system Dynamics (2014-15)</td>
</tr>
<tr>
<td></td>
<td>LSUASC Human Factors at an FAA UAS Test Site (2014-17)</td>
</tr>
<tr>
<td></td>
<td>TAMUCC Development of Advanced Remote Sensing Tools (2015-20)</td>
</tr>
<tr>
<td></td>
<td>TAMUCC Sense and Avoid Research (2014-18)</td>
</tr>
</tbody>
</table>
# Planned Research Missions

## Completed

<table>
<thead>
<tr>
<th>Date</th>
<th>Aircraft Type</th>
<th>Location</th>
<th>R&amp;D Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015 August</td>
<td>Rotary wing</td>
<td>California</td>
<td>NASA UTM Build 1 Demonstration</td>
</tr>
<tr>
<td>2015 September</td>
<td>Fixed wing</td>
<td>400’ South Texas</td>
<td>O&amp;G Maintenance and application-specific data collection</td>
</tr>
<tr>
<td>2015 September</td>
<td>Fixed wing</td>
<td>Northeast Alabama</td>
<td>Conduct wildlife monitoring missions in four counties</td>
</tr>
<tr>
<td>2015 Fall</td>
<td>Fixed wing</td>
<td>South Texas</td>
<td>Support industry partner flying missions for a large government agency</td>
</tr>
<tr>
<td>2015 Fall</td>
<td>Fixed wing and rotary wing</td>
<td>South Texas</td>
<td>Develop and implement survey methods for a government partner</td>
</tr>
<tr>
<td>2015 Fall</td>
<td>Fixed wing</td>
<td>Laguna</td>
<td>Develop precision agriculture methods with industry partner</td>
</tr>
<tr>
<td>2015 Fall</td>
<td>Fixed wing</td>
<td>Padre</td>
<td>Conduct wildlife monitoring with industry partner</td>
</tr>
<tr>
<td>2015 Winter</td>
<td>Fixed wing</td>
<td>Laguna</td>
<td>Perform final assembly checkout for a major aerospace company</td>
</tr>
</tbody>
</table>

**Planned missions will build on prior successes to:**

- Validate our distributed communications infrastructure
- Evaluate sense and avoid and situational awareness tools
- Validate LSUASC processes and procedures
LSUASC Search and Recovery Operations
LSUASC Search and Recovery Operations
Texas River Flood Support Lessons Learned

- Proper Prior Planning Prevents Poor Performance
- Be Prepared for the Unexpected
- Minimize Logistic Footprint
- Be Prepared for the Environment
- Work with Incident Command
- Train
- Learn How to Communicate
- Team Composition
- Be Safe
LSUASC Night Operations
# UAS Vision for Texas

## Why Texas?

<table>
<thead>
<tr>
<th>UAS Market</th>
<th>National Level Ranking by State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge Inspection</td>
<td>1 &gt;50,000 bridges</td>
</tr>
<tr>
<td>Precision agriculture</td>
<td>2 &gt;27M acres of Crop Land</td>
</tr>
<tr>
<td>Oil production monitoring</td>
<td>1 ~500 offshore oil platforms &gt;350,000 miles of pipelines</td>
</tr>
<tr>
<td>Power line inspection</td>
<td>1 &gt;3,500 miles of power lines</td>
</tr>
<tr>
<td>Railroad track inspection</td>
<td>1 &gt;10,000 miles of railroads</td>
</tr>
<tr>
<td>Wind turbine inspection</td>
<td>1 &gt;7,000 wind turbines</td>
</tr>
<tr>
<td>Border inspection</td>
<td>2 &gt;1,200 miles of border</td>
</tr>
<tr>
<td>Port Security</td>
<td>2 4 of top 11 ports are in Texas</td>
</tr>
<tr>
<td>Coastline monitoring</td>
<td>7 &gt;3,000 miles of coastline</td>
</tr>
</tbody>
</table>

Essential we get it right!
Firefighting
Hurricane Genesis and Monitor
National Security

UAS National Security Response Vision

Washington State
Grand Forks, ND
PED Cell
Fort Drum, NY
Washington, DC (Air & Marine Headquarters)
Oklahoma City, OK (National Air Training Center)
Gray Butte, CA (Flight Test Center)
AMOC
Tucson, AZ
Sierra Vista, AZ
Cape Canaveral, FL
Corpus Christi, TX
Puerto Rico (Air Operations Ctr.)

Launch and Recovery
Mission Control
Launch and Recovery / Mission Control
Future Launch and Recovery / Mission Control

U.S. Customs and Border Protection
Ocean Research
Oil & Gas Commercial Inspections

Onshore Commercial Operations
- Fixed wing UAS
  - Infrastructure integrity
  - Flare stack
  - Environmental monitoring
  - Asset security
  - Pipeline patrol
  - Wildlife assessment
  - Tank inspections
- Early detection of oil slick
- Health, Safety, Security & Envt (HSSE)

Offshore Commercial Operations
- Medium Altitude Long Endurance UAS
  - Cargo transport
  - Infrastructure integrity
- Early detection of oil slick
- Flare stack
- Under deck integrity
- Asset security
- Cargo helicopter UAS
Plant Disease Detection
LSUASC Outreach Campaign

Campaign Framework

National Users
And Stakeholders
Elected Federal Officials
The FAA
Other Test Sites
Other Government Agencies
National Oceanic & Atmospheric Administration
National Science Foundation
National Geodetic Survey

Texas State Agencies
The Texas Legislature
Texas Elected Officials
TX DOT-Aviation
TX Parks and Wildlife
Texas A&M Agrilife Extension Service
TX General Land Office
TX Department of Public Safety
TX Natural Resources Information Systems
TX Railroad Commission
TX Commission on Environmental Quality

The Public
Safety
Privacy
General Aviation, EAA, AOPA
The Media
Community Town Hall Events
Environmental

The Team
and R&D Sponsors
TEES
UTARI
SWRI
Texas Tech
TAMU-CS
TAMU-CC
BayTech (JSC)
UTSA
Camber

National & International Industry Users
~300 UAS Mission Areas
UAS OEMs
Agriculture, Wildlife & Fisheries
Oil and Gas
Maritime and Ports
Public Safety
Future-Commercial-Space
Real Estate
GIS
Process to Civil Certification To Fly For Commercial Purposes

UAS Paths to Civil Operations

SECTION 333
- < 400 Foot AGL
- < 55 LBS VLOS
- < 100 MPH
- No R&D
- Limited Approval

SMALL USER RULES
- 2016 Limitations

TYPE CERTIFICATE PROGRAM
- Establish Rules
- Flight Test Area
- Cert. Basis: 14CFR21.17(b) (Special Class)
- Limited R&D
- Air Worthiness (SAC EC)
- 3 Yr. Program

TEST SITES
- R&D
- UAS DAR
- Air Worthiness (SAC EC)
- Industry Support

EXEMPTION To 91.319
- Experimental

Civil Certification

Test Site Supported
UAS Operator Regulations  
(September 2015)

FAA  
www.faa.gov/uas/what_can_you_do_with_your_uas/

• Hobbyist, Public (governmental) or Civil (Commercial, Industry, and non public)
• Hobbyist Rules – Follow model aircraft operations
• Public or Civil
  – Aircraft Registration – The UAS must be registered
  – COA (60 days) – Certificate of Authorization or Waiver
  – Section 333 Exemption (90 days) – Grant of FAR exemptions

State of Texas

• Texas Privacy Act – Video/Imagery protection for citizens
• Department of Public Safety - Limitation of UAS use around Capital Complex
• Critical Infrastructure Facilities – flying less than 400’ above ground
  over facilities not allowed

Important Info

• Knowbeforeyoufly.org
• www.lsuasc.tamu.edu
Kelvin Solco
Regional Administrator, Southwest Region
Federal Aviation Administration

Mr. Solco holds a Bachelor’s Degree in Civil Engineering from Prairie View A&M University and a MBA from LeTourneau University. He is a graduate of the Senior Executive Fellows Program at Harvard University. He is a registered professional engineer in the State of Texas and has been with the FAA for 33 years and was appointed as the FAA’s senior executive and principal representative of the Administrator for this region in 2014.
Elizabeth Soltys
Manager of the FAA’s UAS Test Site Program
Federal Aviation Administration

Ms. Soltys is 25-year FAA veteran with experience in air-traffic control, research and full-scale development systems. She managed inter-agency agreements with NASA and the DOD. Elizabeth managed contracts supporting the Next Generation Air Transportation System with an estimated value of $6.4 billion over 10 years. This program is the largest set of awards in FAA history. She has a BS in Applied Mathematics, a five-year engineering degree with emphasis in structural engineering, and a MBA in Finance and Accounting.
Dr. Luis Cifuentes
Vice President for Research, Commercialization
And Outreach
Texas A&M University - Corpus Christi

Dr. Cifuentes holds a Bachelor’s Degree in Chemistry from Swarthmore College, a Masters Degree in Marine Studies from the University of Delaware and a Ph.D. in Oceanography from the University of Delaware. He served as interim Executive Director of the Lone Star UAS Test Site until September 2015.
Al Davis
Deputy Director
Texas A&M Engineering Extension Service (TEEX)

Al is a 28 year veteran of the U.S. Marine Corps and holds a Bachelor’s Degree from Southern University and a MBA from Averett University and a Master of Science degree from the National Defense University, Industrial College of the Armed Forces. He has been affiliated with TEEX since 2004.
Coitt Kessler
Program Manager
Robotic Emergency Deployment Team
Austin Fire Department

Coitt is a 15-year veteran with the Austin Fire Department. He received the 2014 “Outstanding Firefighter” Award.
Chip Urban attended the University of Texas at Austin and received a Bachelor’s Degree in civil engineering from the University of Texas at San Antonio. He received his P.E. License in 2003 and his R.P.L.S. License in 2009. He became a Principal with the firm in 2009. He splits time between leading the Survey Department and managing engineering projects.
UAS Panel of Experts
Tripp Riedel

Alexander “Tripp” Riedel
Director of Aviation
Valero Energy Corporation
Tom Frierson
Safety Officer
Lone Star UAS Center of Excellence & Innovation
Modern Technology Solutions Inc. (MTSI)

Tom served as a Safety Officer in the US Army for over 22 years and received a Bachelors of Science in Geography from Texas A&M University. He is the recipient of several military awards, including the US Army Combat Action Badge, two Bronze Stars, two Air Medals, five Meritorious Service Medals, and the US Army Master Aviator Badge. His ratings include private pilot and commercial Rotorcraft-Helicopter Pilot with over 3000 hours.
Questions and Answer Session

Twitter #askLSUASC
The Way Forward

• Provide assistance. Plan, Operate, Evaluate (POE)
• Engage industry and local, state, and federal governments for funding opportunities
• Expand the distributed research environment
  – Mature Mission Control Center (MCC), Mobile Mission Control Centers (MMCCs), and Range Operations Centers (ROCs)
• Adapt research infrastructure to address diverse research interests to support Beyond Visual Line of Sight (BVLOS) research
• Establish UAS Training Center of Excellence
• Engage our newly named Advisory Group
Plan → Operate → Evaluate

**Plan**
- FAA Coordination
- COA Development
- Notice to Airmen (NOTAMS)
- Flight Readiness Review
- Daily Brief
- Safety Reviews / Checklists
- Section 333
- Integration Labs

**Operate**
- Aircraft & Sensors
- 200’ and 400’ Blanket COAs
- Texas Ranges
- Certified Operators
- Training

**Evaluate**
- Data Regression Tools
- Doctoral GIS Program
Doing Business with the LSUASC

- Process is straightforward, designed to accommodate clients
- Each SOW is unique, developed through dialogue, patterned to specific requirements of client
- TRUST meeting designed to minimize potential misunderstandings
- Checklist approach to needs assessment ensures thorough discussion of potential requirements

*TRUST: Test Site Resource Utilization Strategy Team
*NDA: Non Disclosure Agreement for Information Protection
Overall Mission Cost is Dependent on Many Factors, Not “One Size Fits All.”

<table>
<thead>
<tr>
<th>Less Expensive</th>
<th>More Expensive</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Simple demonstration in VLOS</td>
<td>• Complex research BVLOS</td>
</tr>
<tr>
<td>• Smaller, simpler aircraft</td>
<td>• Larger, heavier, more capable aircraft</td>
</tr>
<tr>
<td>• Pilot license not required</td>
<td>• Pilot license required</td>
</tr>
<tr>
<td>• Little or no data processing</td>
<td>• Extensive data processing</td>
</tr>
<tr>
<td>• No training required</td>
<td>• Substantial training required</td>
</tr>
<tr>
<td>• Existing COA</td>
<td>• New or modified COA required</td>
</tr>
<tr>
<td>• Client already has mature safety &amp; operational procedures</td>
<td>• Client has immature safety &amp; operational procedures</td>
</tr>
</tbody>
</table>

Increasing Complexity

- Location/Logistics requirements
- Type, size, complexity of aircraft
- Operator credential requirements
- Type and complexity of payloads
- Amount of data processing required
- Security requirements
- Airworthiness evaluation required?
- Type and amount of training required
- Maturity of safety and operational procedures
- Experience and qualifications of client team
- Nature of the mission (Duration, frequency)
- Visual Line of Sight? (Need for visual observers or chase plane)
Expand the LSUASC Nodal Based Command and Control Architecture
Architectural Expandability Supports UAS National Proliferation

Nodal Architecture

1 ... N

UAS in the NAS

LSUASC Arch Today

LSUASC Arch DAA

LSUASC Arch Mixed Airspace

LSUASC Arch Sat/Com Full C&C

LSUASC Arch Regional / State

Nation Arch

Full Airspace Integration

Architecture Expansion Plan
LSUASC Research in Beyond Visual Line of Sight

Development of Rules, Regulations and Procedures using disciplined Crawl, Walk, Run approach!
LSUASC Advisory Group Members

Nancy Archuleta
Business Executive
(High Technology Area)

Mike Gallagher
Former FAA Airworthiness & FAA
Senior Executive

Keith Graf
State of Texas,
Office of the Governor

The Honorable Kay Bailey Hutchison
Former US Senator from State of Texas

Dr. Jon Mogford
Vice Chancellor for Research
Texas A&M University System

Dr. Ellen Ochoa
Former Astronaut and current Director
of Johnson Space Center

Emilio Pena
President and CEO
Houston Clean Energy Park
Takeaways!

• 100% Safe Operations
• Clear airspace
• National reach
• Operational credibility
• Scalable infrastructure
• Robust research capacity
• Beyond Visual Line of Sight Focused Research
• Trusted Agent
• Making an Impact!
Thanks to all who attended or joined around the world and to all those who worked so hard to make this event happen!