





Nicholls State University

DR. BALAJI RAMACHANDRAN
CONTRACTORS EDUCATIONAL TRUST FUND SUPER ENDOWED
PROFESSOR
T BAKER SMITH ENDOWED PROFESSOR
HEAD & GEOMATICS PROGRAM COORDINATOR
DEPARTMENT OF APPLIED SCIENCES

**EMERGING sUAS TECHNOLOGY
FOR OIL & GAS INDUSTRY**



**NICHOLLS GEOMATICS
PROGRAM**

- Nicholls Geomatics Program – recipient of NCEES 2016 Surveying Education Award
 - Top ten in the nation (out of 89 programs)
- Completed 13 years in Spring of 2016
- Over 3 million dollars in state of the art Geospatial technology facilities

TALK OVERVIEW

- Nicholls sUAS current R&D focus and FAA approved research sites
- Regulatory environment
- Nicholls current sensors and sUAS platforms
- Future sensors and sUAS platforms
- Geomatics UAS education and technical certification
- Potential O&G sUAS applications
- Q&A

sUAS CURRENT R&D FOCUS

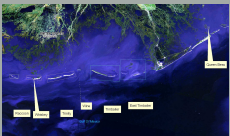
FAA APPROVED RESEARCH SITES

**sUAS test site
Nicholls Farm**

**Instruction and
Research**

FAA APPROVED RESEARCH SITES

Barrier Islands



USACE- Old River Control Structure



Old River Training Site
 (30° 14' 17.0" N, 90° 23' 30.0" W)
 Top Right Corner: 30° 14' 17.0" N, 90° 23' 30.0" W
 Top Left Corner: 30° 14' 17.0" N, 90° 23' 30.0" W
 Bottom Right Corner: 30° 14' 17.0" N, 90° 23' 30.0" W
 Bottom Left Corner: 30° 14' 17.0" N, 90° 23' 30.0" W

FAA APPROVED RESEARCH SITES

Terrebonne Levee District



Shell Deepwater Platforms



11 Platforms Selected for this R&D Program

Platform Name	Lat	Long	Altitude
1	28.5	-90.5	100
2	28.5	-90.5	100
3	28.5	-90.5	100
4	28.5	-90.5	100
5	28.5	-90.5	100
6	28.5	-90.5	100
7	28.5	-90.5	100
8	28.5	-90.5	100
9	28.5	-90.5	100
10	28.5	-90.5	100
11	28.5	-90.5	100

REGULATORY ENVIRONMENT

- FAA Modernization and reform act 2012
- COA vs Experimental certification vs Section 333 exemptions v/s Part 107
- Six UAS test sites
- Small UAS Notice of Proposed Rulemaking (NPRM)
- Blanket COAs
- Micro UAS Rule?
- Congressional proposals
- Federal privacy acts
- State legislation
- Local restrictions

REGULATORY ENVIRONMENT

12. If you see another machine near you, get out of the way.

6. Pilots should carry handkerchiefs in a handy place to wipe off goggles.

21. Pilots will not wear spurs while flying.

25. If an emergency occurs while flying, land as soon as possible.

Source: Drones & Next Era of Aviation – Jonathan Evans, Presentation, 2015 – UAS conference Reno, NV.

REGULATORY ENVIRONMENT

FAA 107 Rules of the Air

Operation: Commercial Drones

- 400 ft max altitude
- 30 ft max distance from person
- Visual Line of Sight
- Visual Observer
- Daylight or civil twilight
- Max 100 mph ground speed
- One UAS per operator
- External load operation only permitted if the load does not affect flight operations or control

REQUESTING A WAIVER

Get the FAA to grant you a waiver for specific operational restrictions

SAFETY

The operator is responsible for the safety of the operation and the safety of the public

ONLINE PORTAL

FAA's online portal for requesting a waiver

APPLICATION DATA

Information required for the waiver application

TIME FOR APPROVAL

Typical time for approval is 30 days

ADDITIONAL RESTRICTIONS

Additional restrictions may be applied to the waiver

LOOKING AHEAD

FAA is working on new rules for drones

PART 107 – OPERATING RULES

- Visual line-of-sight, Class G airspace
- Daylight or civil twilight
- No operations over people
- Must yield right-of-way to manned aircraft
- Max groundspeed of 100 mph
- One UAS per operator
- External load operation only permitted if the load does not affect flight operations or control

PART 107 – AIRSPACE REQUIREMENTS

- Operations in Class G are allowed without air traffic control authorization
- Operations in Class B, C, D airspaces, and Class E airspace designated for airports require authorization from ATC

The diagram illustrates the vertical structure of airspace classes. At the top is Class A, starting at 18,000 MSL and extending to FL 600. Below Class A are Class E and Class D airspaces, both starting at 1,200 AGL. Class E extends to 14,500 MSL, while Class D is limited to 400 feet AGL. Between Class E and Class D are Class C and Class B airspaces, both starting at 1,200 AGL. Class C extends to 4,000 feet AGL, and Class B extends to 5,000 feet AGL. Below Class B is Class G, which extends from the surface up to 1,200 AGL. The diagram also indicates that Class G is the only class that can be found at non-towered airports with no instrument approach.

PART 107 – WAIVABLE PROVISIONS

- Operation from a moving vehicle or aircraft (§ 107.25)
- Daylight operation (§ 107.29)
- Visual line of sight aircraft operation (§ 107.31)
- Visual observer (§ 107.33)
- Operation of multiple small UAS (§ 107.35)
- Yielding the right of way (§ 107.37(a))
- Operation over people (§ 107.39)
- Operation in certain airspace (§ 107.41)
- Operating limitations for small UAS (§ 107.51)

The image shows a 'Certificate of Waiver or Authorization' form from the FAA. It includes fields for the applicant's name, the type of operation, and the specific provisions being waived. The form is signed by the Administrator of the FAA and dated January 14, 2016.

Nicholls State University

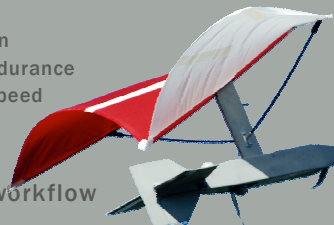
REGULATORY ENVIRONMENT

HOLY COA!!!
Terrebonne
Levee
District



SENSOR & PLATFORMS

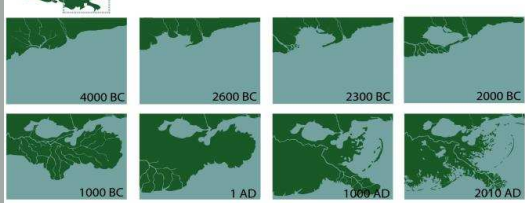
- **CyberBug**
 - Turret Sony FCB-IX block camera
 - 2.5 lb. payload
 - 55 in. wingspan
 - 45 minutes endurance
 - 22 Kts. max. speed
- Surveillance workflow
- 2007-2011





COASTAL RESTORATION & MONITORING

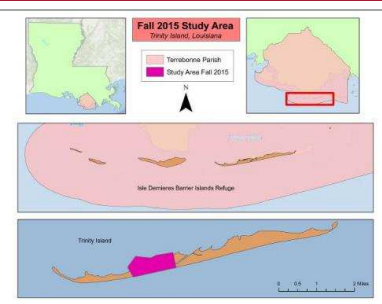
Coastal Louisiana Land Loss



Smith, D.L., 1989. Series and historical trends of landscape modification, reduction in sediment availability, and habitat incision/erosion in the Atchafalaya and Terrebonne Riverine Systems. NPS/USFWS, No. 89, Terrebonne, LA. 88 pp.
Kilham, W., Wengert, L., Nicholas, K.A., & Pritchard, L. 2005. Coastal land status of Louisiana: The late Pleistocene. Coastal Geology Technical Report No. 5, Louisiana Geological Survey and University of Maryland, Southern, Baton Rouge, Louisiana, USA. 40p.



ISLE DERNIERES BARRIER ISLAND REFUGE



Fall 2015 Study Area
Terrebonne Parish, Louisiana
Isle Dernieres Barrier Islands Refuge
Tertiary Island

0 0.5 1 2 Miles

FIRST MISSION OVER TRINITY ISLAND

- **CyberBug**
- **Volunteer Pilots**
 - Mr. Christen
 - Mr. Hicks
- **Collaborators**
 - FTCC
 - COTS

FIRST MISSION OVER TRINITY ISLAND

- 640 X 480 image frames from video
- Geotagged video frames were used for visual analysis

FIRST MISSION OVER TRINITY ISLAND

- 640 X 480 image frames from video
- Geotagged video frames were used for visual analysis

CURRENT SENSOR & PLATFORMS

- **Trimble UX5**
 - Catapult launch
 - Belly landing
- Photogrammetry workflow
- 2014 - Present

CURRENT SENSOR & PLATFORMS

- **Trimble UX5**
- Sony NEX-5T, True color, Infrared sensitive

ISLE DERNIERES BARRIER ISLAND REFUGE (IDBIR)

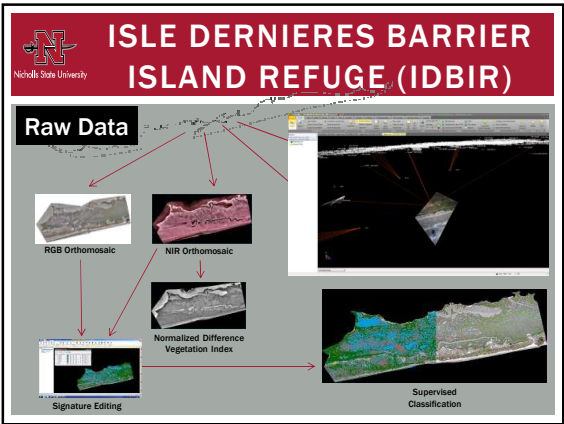
Field Methods
Photo Mission Planning

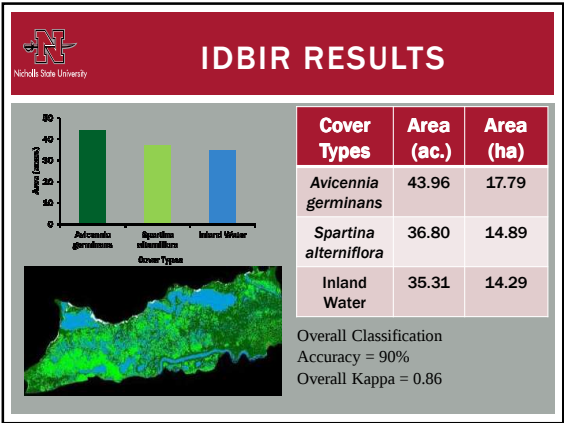
GNSS Static Survey
OPUS Solutions

Phototargets

Mission Planning

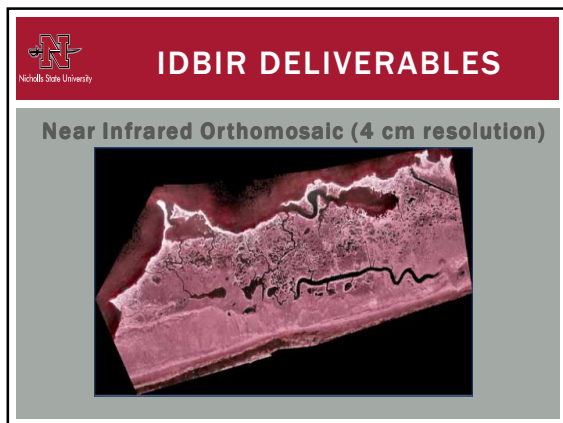
Duplicate Missions

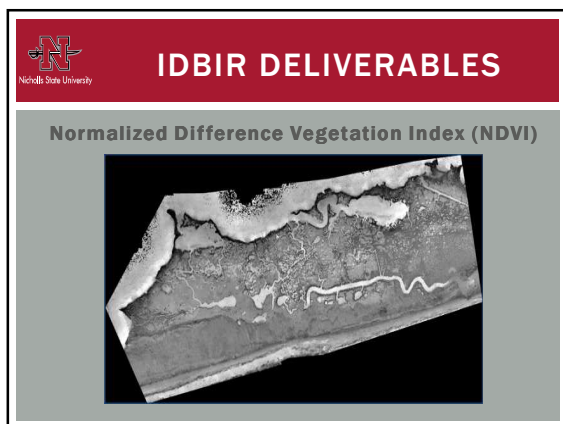


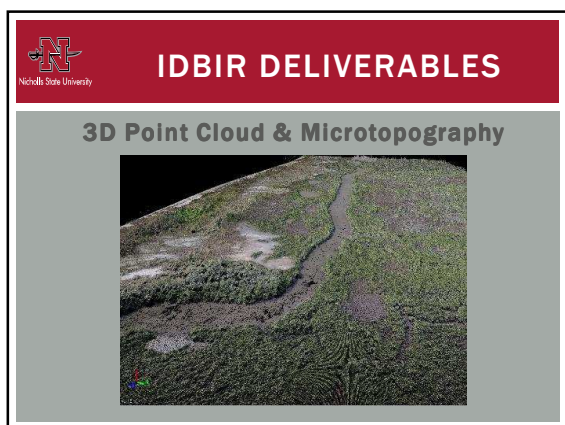


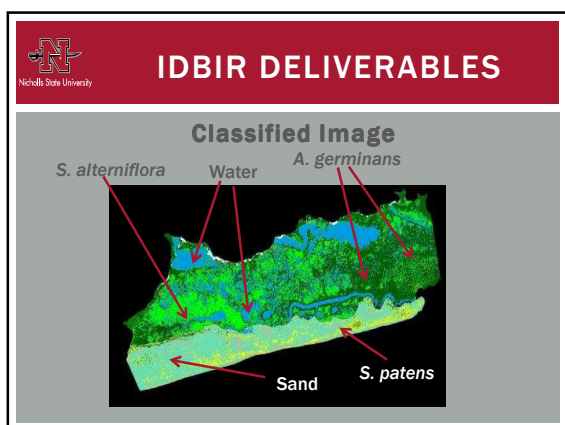


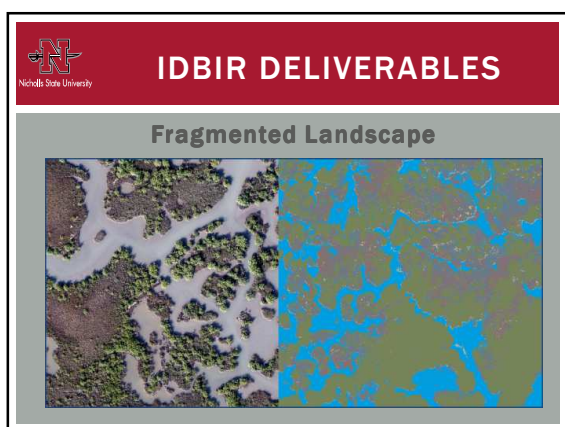












IDBIR DELIVERABLES

Object Based Feature Extractions

Two Mangrove leaves

Two Oysters

CURRENT SENSOR & PLATFORMS

- **Trimble UX5 HP**
 - 36MP- High resolution Sony α7 camera
 - 15, 25, 35mm lens
 - 35 minutes endurance
 - 1 cm to 25 cm resolution
 - Few photo targets - PPK
- Photogrammetric workflow
- 2016 - present

TERREBONNE LEVEE MONITORING PROJECT

True Color Orthomosaic (1 cm resolution)

TERREBONNE LEVEE MONITORING PROJECT

OrthoDigitalSurface (DSM) model of the levee



TERREBONNE LEVEE MONITORING PROJECT

Flood Control Structure (3D point cloud)



RECENT ACQUISITION TO NICHOLLS FLEET

**MULTIROTOR
Surveying Robot**



Specifications

- Payload up to 6.5 kg
- Max. takeoff wt. ~10kg
- Altitude >40m /1cm resolution
- Flight endurance 20 minutes

STRATEGIC PETROLEUM RESERVE (SPR)

- A public private partnership with focus on research and development of sUAS for facility security and oil spill response
- CONOPS development and validation of Technologies, Techniques and Procedures (TTP)
- Baseline mapping and modeling of the site using sUAS
- Geo-fencing strategies for facility security operations, maintenance operations, and emergency response plans/procedures

STRATEGIC PETROLEUM RESERVE (SPR)

- Obstacle avoidance and waypoint navigation for assessing alarm threats from exclusion zones
- Demonstrate Oil leak/spill technology to better estimate thickness, direction, and speed of advance
 - Remote oil monitoring sensors (Optical, thermal Infrared, LiDAR, SAR)
 - Active oil monitoring sensors (dropping, dipping, and towing)
- Develop Beyond-Line-Of-Site (BLOS) TTPS
 - Design, develop, and implement LTE cellular UAS connectivity
 - Demonstrate real-time video connectivity over cellular LTE network
 - Video and Image analytics
 - VideoBank – New Jersey firm collaborating with us on digital asset capture, management, and retrieval technology

FUTURE SENSORS UNDER CONSIDERATION

Sensor	Technical Specifications
RIEGAL - VUX-1UAV LiDAR	Active, 3.85 kg, Near InfraRed (NIR), FOV: 330°, 10 mm accuracy with 5 mm precision, 10-200 scans/sec and 300-1500m range.
Velodyne – VLP16 LiDAR	Active, 830 grams, NIR, FOV: 30°, 3 cm accuracy, 300,000 points/sec@ 30°, and 100m range:
Headwall – Nano - Hyperspectral	Passive, 1.15 lbs. (without lens), Visible – NIR, 270 Spectral Bands, FOV: 15.9° and 3 cm accuracy



POTENTIAL OIL & GAS APPLICATIONS

- **sUAS and Line of Sight (LOS)**
 - Offshore critical infrastructure monitoring and inspection
 - Air pollution monitoring to meet the required environmental standards (Methane)
 - Marine mammal monitoring
 - Bird habitat mapping (rookeries along the coast)
- **UAS and Beyond Line of Sight (BLOS)**
 - Onshore pipeline corridor mapping and monitoring
 - Disaster response and recovery
 - Oil spill detection and monitoring
 - Facility security operations



GEOMATICS UAS EDUCATION

Suggested Course Topics – 30 credit hrs. 1 plus year

• Overview of UAS applications — military, commercial, and civil	• Introduction to aerodynamics principles
• System components / integration	• Mission planning and coordination
• Best practices: sensors, and data management	• Sensors, datalink, & geospatial information systems
• UAV operations, program administration and policy	• Focus course for law enforcement
• ATC services, aviation regulations and airspace	• Safety and communications



GEOMATICS UAS TECHNICAL CERTIFICATION

Suggested UAS Technical Certification Courses – 6 credit hrs.

• Semester 1:	• Introduction to UAS; Private Pilot Ground School; Aviation Meteorology; UAS Standards, Regulations and Law; and ATC Communication.
• Semester	• Survey Crew Resource Management for UAS; UAS Flight Operations; UAS Maintenance; and UAS Sensors.

COLLABORATORS

- **Dr. Gary LaFleur Jr**
 - Associate Professor of Biological Sciences, Director Bayou Studies Program and LUMCON Summer Instructor 2000 – Present
- **COTS Technologies LLC**
 - Cdr. R. George Rey Sr., President
 - Mr. Peter Jansen
 - Pilot and Aviation safety expert
- **NEI/Trimble Navigation Ltd**
 - **Students**
 - Mr. Frank Yrle - Graduate student (Biological Sciences)
 - Mr. Daniel Drennan (UG – Geomatics)
 - Mr. Cody Parks (Geomatics Alumni)
 - Mr. Paul LeBlanc (Geomatics Alumni)
 - Mr. Gavin Chauvin, (UG), Ms. Whitney Nelson (UG), Mr. Adam Kemberling (Grad), Biological Sciences)

Q&A

- Thank you
- Contact Information:
 - Dr. Balaji Ramachandran
 - Head and Geomatics Program Coordinator
 - Department of Applied Sciences
 - URL: <http://www.nicholls.edu/doas>
 - Ph.: (985)-448-4724
 - Email: balaji.ram@nicholls.edu

PART 107 – ANTICIPATED WAIVER REQUEST

- **Operations over people**
 - Three particular Section 333 Exemptions provide guidance for waiver safety mitigations
 - Industrial Skyworks
 - Kansas State
 - Cape Productions
 - Micro UAS ARC report also provides guidance for safety mitigations
- **Night operations**
 - Part 107 permits civil twilight operations with anti-collision lighting visible for min. 3 statute miles
 - Guidance for waiver safety mitigations for night operations included in Section 333 Exemption to Industrial Skyworks

Aeronautical Knowledge Exam Topics

- Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation
- Airspace classification and operating requirements, and flight restrictions affecting small unmanned aircraft operation
- Aviation weather sources and effects of weather on small unmanned aircraft performance
- Small unmanned aircraft loading and performance
- Emergency procedures
- Crew resource management
- Radio communication procedures
- Determining the performance of small unmanned aircraft
- Physiological effects of drugs and alcohol
- Aeronautical decision-making and judgment
- Airport operations
- Maintenance and preflight inspection procedures



PART 107 – HELP / INFORMATION



- UAS Help Line: 844-FLY-MY-UA
- UAS Email: UASHelp@faa.gov
- Knowledge Test Service Providers
 - CATS: 800-947-4228
 - PSI: 800-211-2754

RESOURCES

Summary of Part 107 – https://www.faa.gov/uas/media/Part_107_Summary.pdf

Part 107 Advisory Circular – https://www.faa.gov/uas/media/AC_107-2_AFS-1_Signed.pdf

Part 107 Online Course – <https://www.faasafety.gov/>

Knowledge test study resources – https://www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot/

Knowledge test study guide – https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/remote_pilot_study_guide.pdf

UAS FAQs – <https://www.faa.gov/uas/faqs/>

ONLINE TOOLS

FAA IACRA – <https://iacra.faa.gov/iACRA/Default.aspx>

Register your UAS – <https://registermyuas.faa.gov/>

Label your UAS – https://www.faa.gov/uas/getting_started/fly_for_fun/media/UAS_how_to_label_Infographic.pdf
