Wing Cheung
Assistant Director, GeoTech Center
PI, UASTEP Program
Professor, Palomar College
wcheung@palomar.edu

Empowering Colleges:
Expanding the
Geospatial Workforce

Drone Operation and
Drone Data Analysis

Based upon work supported by the National Science Foundation
under Grant DUE ATE 1304591 and 1700552. Any opinions,
findings, and conclusions or recommendations expressed in this
material are those of the author(s) and do not necessarily reflect
the views of the National Science Foundation.
IMAGINE SEE THE POSSIBILITIES
with 30 minutes
Northern California Fires
Types of Drone Operation

• Public operation
  – Local, state, federal government
  – Certificate of authorization (COA)
  – Part 107 remote pilot license

• Civil operation
  – Commercial
    • Businesses, Educators (flight training)
    • Part 107 remote pilot license
    • Register each aircraft
  – Recreational
    • Hobbyists, Educators (outreach, allied fields)
    • Don’t need remote pilot license
    • Must operate under community based safety guideline
    • Register pilot
## Civil Operation Regulations under Part 107

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Commercial</th>
<th>Recreational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration</td>
<td>• Register each aircraft</td>
<td>• Register pilot</td>
</tr>
<tr>
<td>Pilot</td>
<td>• At least 16 year old to get license</td>
<td>• At least 13</td>
</tr>
<tr>
<td></td>
<td>• <em>Must pass Part 107 initial aeronautical knowledge test</em> (at least 14 years old)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Vetted by Transportation Safety Administration</td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>• Aircraft must be less than 55 lbs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Visual line of sight</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Under 400 feet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Daylight operation only</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fly slower than 100 mph</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Do not fly over people, emergencies, or sporting events</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Research <a href="https://www.geotechcenter.org">airports and airspace</a></td>
<td></td>
</tr>
</tbody>
</table>
I FLY SAFE

All drones are aircraft—even the ones at the toy store. So when I fly a drone I am a pilot. Before I fly I always go through my pre-flight check list. I regularly check the safety guidelines at faa.gov/uas

PRE-FLIGHT CHECKLIST

- I fly below 400 feet
- I always fly within visual line of sight
- I’m aware of FAA airspace requirements: faa.gov/go/uastfr
- I never fly over groups of people
- I never fly over stadiums and sports events
- I never fly within 5 miles of an airport without first contacting air traffic control and airport authorities
- I never fly near emergency response efforts such as fires
- I never fly near other aircraft
- I never fly under the influence

FLY SMART, FLY SAFE, AND HAVE FUN!

Federal Aviation Administration
knowbeforeyoufly.org | faa.gov/uas
Starting a Drone/UAS Program?

• Things to consider:
  – Liability issues
  – Area(s) of focus
  – Campus Policies
  – Local regulations
  – Hardware (UAV, Sensor), Software

DRONE DATA ANALYSIS
Take a look at the basic components of a drone.

**FLIGHT CONTROLLER**
Interprets input from onboard sensors and regulates speed, steering and cameras

**GPS MODULE**

**PUSHER PROP**
Contra-rotating propellers that eliminate motor torques

**ELECTRONIC SPEED CONTROLLER**

**STANDARD PROP**
Propellers that pull the drone through the air

**MOTOR**
Usually a brushless electric type, which is more efficient, reliable and quiet

**BOOM**
Short booms are easier to maneuver, while long booms are more stable

**MAIN BODY**
Houses battery, avionics, cameras and sensors

**RADIO RECEIVER**

**BATTERY**
Usually a lithium polymer battery

**GIMBAL**
Rotating mount that provides stabilization and points cameras or sensors

**CAMERA**

**LANDING GEAR**

Image source: https://hilite.org/56595/recent-updates/drone-zone/
Examples of Drone Sensor/Camera

1. Passive: Color (RGB) camera

2. Passive: Thermal infrared sensor (FLIR Duo R)

3. Passive: Multispectral sensor (RedEdge)

4. Active: LiDAR (Velodyne Puck)
UNSUPERVISED CLASSIFICATION WITH DRONE MULTISPECTRAL DATA
Application
Automated grouping and classification of similar pixels into distinct classes
Exercise #1

• Download instructions and data at: http://bit.ly/uastep1401
ASSESSING VEGETATION HEALTH WITH DRONE MULTISPECTRAL DATA
This is a web mapping application comparing the aerial photo (left) of Palomar College’s Arboretum with its Normalized Difference Vegetation Index (NDVI) processed image (right). The NDVI images were captured using the 3DR Solo quadcopter equipped with MAPR NDVI camera. The images were processed using Photoscan, Images, and ArcMap.

The legend for interpreting the pixel values (colors) seen in the NDVI photo can be found here.

Image credit: Mark Beavis; Illegible Credits
Concept

- Normalized Difference Vegetation Index (NDVI)
  - \((\text{NIR-RED})/(\text{NIR + RED})\)
  - Healthy: absorbs RED, reflects NIR
- Other indices (Hunt et al., 2013)

Image source: https://earthobservatory.nasa.gov/Experiments/ICE/panama/panama_ex2.php
Exercise #2

• Download instructions and data at: http://bit.ly/uastep1402
CREATING DIGITAL HEIGHT MODEL
WITH LIDAR AND POINT CLOUD DATA
The ‘magic’ of photogrammetry

Image source: Austin Mason (Carleton College), Jay Cassano (Fast Company)
Exercise #3

• Download instructions and data at: http://bit.ly/uastep1403
About UASTEP
Unmanned Aircraft System operations Technician Education Program

www.uastep.org

Objective: Prepare qualified UAS operators and entrepreneur for the workforce

• Academic Programs (Certificate, Associate’s Degree)
• Professional Development Workshops
• Business Competencies and Internships for Students
• Summer Academies and Outreach
Drone-Con 2018

JULY 6TH
San Diego, CA

Space is Limited, Register now!
www.palomaruas.weebly.com
Thank you!

Wing Cheung
Assistant Director, GeoTech
http://www.geotechcenter.org/
Principal Investigator, UASTEP
www.uastep.org
Professor, Palomar College
wcheung@palomar.edu