DRONE MAPPING BASICS – How to get started
Introductions

Daniel Murphy, Technical Support Engineer
daniel.murphy@sensefly.com
### In this talk...

<table>
<thead>
<tr>
<th>Topic</th>
<th>Duration (1 hour total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductions and Presentation of Company</td>
<td>&lt; 5 min.</td>
</tr>
<tr>
<td>Mapping Drones</td>
<td>15 min.</td>
</tr>
<tr>
<td>Processing Drone Data</td>
<td>10 min.</td>
</tr>
<tr>
<td>eMotion Demo</td>
<td>5 min.</td>
</tr>
<tr>
<td>Pix4D Demo</td>
<td>5 min.</td>
</tr>
<tr>
<td>Example Data / Use Case</td>
<td>10 min.</td>
</tr>
<tr>
<td>Questions</td>
<td>10 min.</td>
</tr>
</tbody>
</table>
About senseFly:
What we do

>100 EMPLOYEES

200 POINTS OF SALE

>100 COUNTRIES SERVED

>370,000 FLIGHTS TO DATE
About senseFly

- Founded in 2009 - spin-off of EPFL (Ecole Polytechnique Fédérale de Lausanne)
- Headquarters in Lausanne, Switzerland
- Business & service office in Washington, DC
- Ag Solutions / field office in Fort Dodge, Iowa
- Integrated within the Parrot Group (publicly traded in Paris, PARRO) since June 2012
- Parrot Group: senseFly, Pix4D, MicaSense, Airinov
our applications

Surveying
Agriculture
Earthworks/monitoring

Urban planning & land management
Research / geodesy
Quarries, aggregates & mining
and of course..

Forestry / Land Management
Mapping Drones

- Concepts
- Workflow
- Products
1. Aerial remote sensing is nothing new. Balloons, kites, satellites and planes have been doing it for a long time.

2. It is very common to use remotely sensed observations to aid decision making.

3. Fusing up-to-date maps and expert knowledge of sites is excellent practice!

4. Remember: drones are a tool, not a complete solution to any one problem.
Filling the Gap

Satellite Imaging
Wait time: Days to Weeks
Typical resolution: 50+ cm

Manned Aviation
Wait time: Weeks to Months
Typical resolution: 10-30 cm
Resolution Matters!

Satellite – good for low resolution applications. Detecting large objects and observing phenomena across a landscape. Very accessible, but not temporally flexible.

Drone – provides high spatial resolution with flexible acquisition schedule.
Photogrammetry
from images to 3D points

Depth from stereoscopic vision

3D points from images with common features
Drone Expectations

- Simple, easy & automatic flight
- Portable/rapid deployment
- Integrated payloads
- Consecutive flights
- High & low resolution
- Reliable & serviceable

Unless it’s R&D you shouldn’t have to “make it work!”
Mapping Drone Platforms

**Multi-Rotor**

+ • Take off / land in tight locations
• Hover
• Fly close to objects
• Document inclined/vertical surfaces
• Video possible (heavier payloads)

- • More mechanical parts
• Shorter flight times / less coverage
• More damage / danger (weight)
• Lower wind tolerance

**Fixed Wing**

+ • Longer flight times / greater coverage
• Handle stronger winds
• Less parts
• Less damage (weight/gliding)

- • Larger take off / landing area
• No hover
• Cannot fly close to objects
Drone Mapping Workflow

1. Import images (Flight Data Manager)
2. Flight planning
3. Setting of on-site GCPs (if necessary, and no RTK/PPK available)
4. Flight
5. Generation of 2D orthomosaic and 3D point cloud/DSM
6. Visual Inspection or Analysis in third-party software
7. Flight setting of on-site GCPs (if necessary, and no RTK/PPK available)
Platform: eBee Plus

- Real-world flight time: 59 min
- Up to 220 ha (540 ac) in a single 122 m (400 ft) flight

☑ Large Coverage
☑ High Precision on Demand
☑ Project Perfect Payloads

Includes eMotion 3!
Sensor: S.O.D.A.

- 20 MP RGB
- Ultra light
- Compact
- Built-in dust and shock protection
- No external moving parts
- Global Shutter
Platform: eBee SQ

- More Precise
- Larger Coverage
- Workflow Compatible
- Affordable
**Sensor: Parrot Sequoia**

- Four filtered 1.2 MP sensors (NIR, RE, R, G)
- One 16 MP RGB sensor
- Upward-facing Sunshine Sensor
- Customized data capture
  - ½ Res.
  - MSP Only
  - MSP + RGB
- Seamless integration
Processing Drone Data

• Concepts
• Workflow
• Products
Biological Solution

Two Cameras
Photogrammetry Solution

Multiple Cameras
Optimal Overlap

>1000 Automatic Tie Points
≈75% image overlap

<100 Automatic Tie Points
≈20% overlap
Agriculture or Dense Vegetation

- 75% frontal overlap
- 75% side overlap
- Image geolocation
- Avoid windy conditions
- Average GSD
  - $\approx 10 \text{ cm/pixel}$
Visualization in the Pointcloud
Visualization the orthomosaic
Processing Time

**Time required for processing:**
- Depends on:
  - No. of images
  - Settings (ground resolution / point density)
- 15 min to several days
- Several PCs reduce time: split data sets by flight

**Specific example:**
- 1 field of corn-v5
- 1 flight of 160 acres
- 5 cm ground resolution (pixel size)
- 394 images
- **Est. 1.5** hrs from landing to reflectance map

**Specific example:**
- 1 area of deciduous forest
- 2 flights covering of 175 acres (80% lateral overlap)
- 2.91 cm ground resolution (pixel size)
- 712 images
- **Est. 14–20** hrs landing to orthomosaic, surface model, point cloud
Product Demonstrations

1. eMotion
2. Pix4D Mapper
eMotion 3: Demo
Pix4DAg: Demo

Nectarines in California
Example Data / Use Cases

- Site overview, leaf off
- 3D mapping and visualization, leaf on
Site overview

Example
3D mapping and visualization

Example
Questions?
Thank You
By monitoring the amount of NIR and visible energy reflected from the plant with a camera, it is possible to determine the health of the plants:

- High NIR reflectance / Low visible reflectance = Healthy
- Low NIR reflectance / High visible reflectance = Unhealthy – stressed
Sensor: thermoMAP

- Senses thermal radiation
- Auto-calibrates in flight
- Customized data capture
  - Single frames
  - Video
- Seamless integration
Photogrammetry Solution

Two cameras
Flavors of Remote Sensing

- **Broadband**
  - cell phone cameras
  - thermal imagers

- **Multispectral**
  - Landsat

- **Hyperspectral**
  - 100s of Bands

- **Ultraspectral**
  - 1000s of Bands