Best Practices for Major Missions for Small UAS

Situation awareness, reconnaissance, surveillance (most common mission)

- First get high resolution images for a 360 deg overview of the area of interest from 30-50m AGL, then land, and immediately create an 2D geo-referenced orthomosaic while flying new missions. They may not ask for it, they may say that isn’t a priority, but it is always used as it gives all the stakeholders a common ground.
- If the mission has a hydrological or terrain component to it, printing a 3D map from the 3D reconstruction makes it much easier for stakeholders to understand what they are looking at. They often don’t have 3D point cloud viewers or mouse/joysticks that make it easy to “fly through” a 3D rendering.
- If the terrain is complex (e.g., bluff, hills), if may not be possible to fly a single elevation without violating AGL restrictions. If using a rotorcraft, consider planning flights as a series of vertical slices through the airspace. If using a fixed-wing...

Structural Inspection (2nd most common)

- Structural inspection favors the use of rotorcraft. The views of interest are generally above 3 stories (inspectors can only see up to 3 stories with binoculars) and elevation views (looking straight on). Satellite, manned, and fixed-wing assets get plane views (looking straight down) and some oblique, but cannot get the elevation views.
- Structural inspection favors the use of real-time video with a structural specialist in the loop (also called teleoperation or remote presence) rather than pre-programmed paths
  - UAS will need to be on the order of 3-5m from the structure to get the views that engineers want; GPS accuracy is poor near structures and with wind shear, the pilot will likely have to stay in the loop to correct movements
  - Engineers won’t know what they want to see or the best viewing angle until they see it
- 3D reconstructions from overhead flights are susceptible to misalignment and ghosting, so they have not consistently provided provably accurate “straight lines” and corners of structures and do not give clear elevation views. As such, they don’t appear to give the engineers any new or better information than a video. Reconstructions that include elevation view imagery may be more valuable but no data on that yet.

Search (3rd most common)

- Search may be either search for persons in distress (e.g., on the roof of their house) or missing person (e.g., have been swept downstream)
- Standard procedure is to take high resolution imagery and then have a group of trained experts examine each image. Since the images are geotagged, it doesn’t matter which images they look at
  - Studies show it is difficult to see a person in an open field with real-time video from a UAV, in part because of glare and small screens
  - Victims may be covered in mud and buried in debris so clumps large enough to contain a body may be put on the list for investigation by a ground team
  - Formal methods exist for rating the accuracy of coders
- The usefulness of infrared has not been established. It appears useful only in early morning.
- No sensor appears to penetrate foliage.

Debris Estimation (4th most common)

- Either rotorcraft or fixed-wing can be used if imagery is geotagged and sent to a post-processing package. However, having access to the “before” terrain may be requires and can be hard to get.
- Two types of debris which may be cleaned up by different agencies:
  - directly related to the disaster, such as trees and materials from a tsunami or storm,
  - household debris, such as carpets, draperies, sheetrock, furniture
- Debris content also is important in estimating removal costs, as vegetation is handled differently from construction and household material

©2015 Center for Robot-Assisted Search and Rescue crasar.org