DRONE SERVICES FIJI

Accurate Mapping using Drones

The fundamentals to obtain true photogrammetric accuracy are still the same

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Excitement and potential of autonomous drones for mapping

For high accuracy mapping - reliably and repetitively

Fundamentals of Photogrammetry remain the same

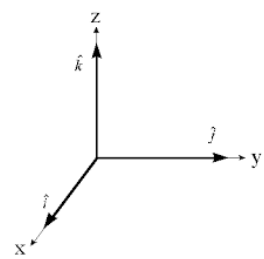
Some definitions

Accuracy: Proximity of measurement results to true values

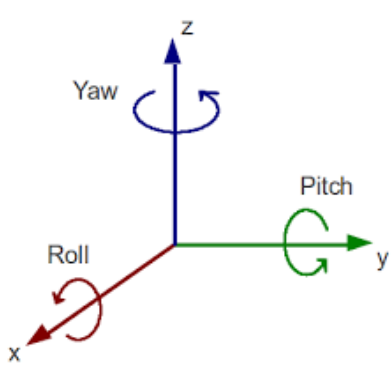
Precision: Reliable and repetitive mapping

Accurate Drone Mapping system:

achievable accuracies in the X, Y and Z (height)
verifiable and repeatable



Recognition, measurement and mathematical treatment of mapping system errors



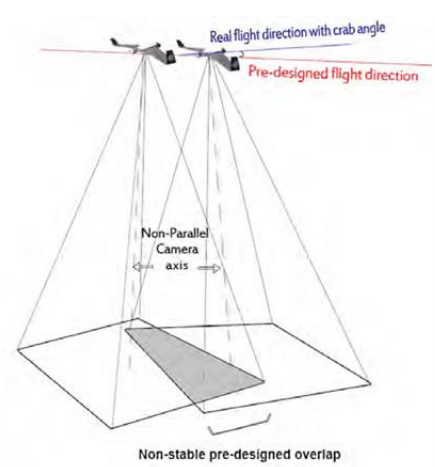
- Roll Ω, Pitch Φ, Yaw, K
- Scaling
- Approximation of parameters

Goal of photogrammetry: accurate measurement of imagery by rigorous treatment of errors

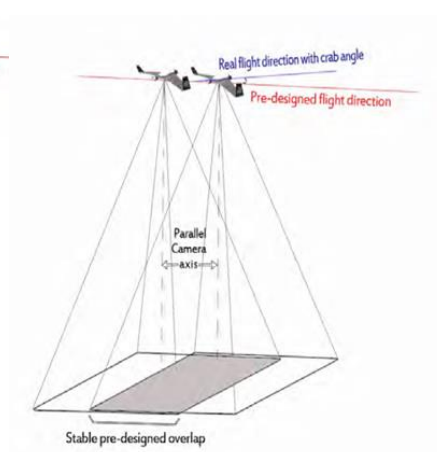
Physical Environment and Sensors

- Aggressive environment
  Wind, turbulence, internal vibration
- Tips, tilts, yaw, forward & lateral motion compensation
- Flight planning and implementation
- Digital v's Commercial Off the Shelf (CTOS) Cameras
- Camera fixed to airframe

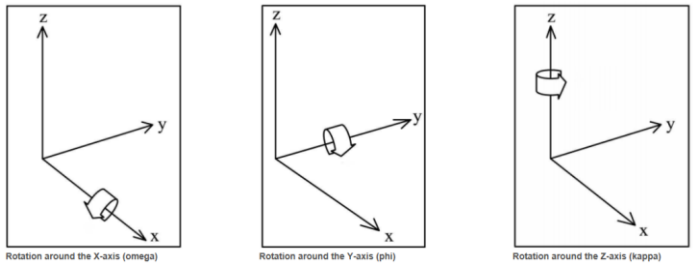
Errors are random, unknown and significant

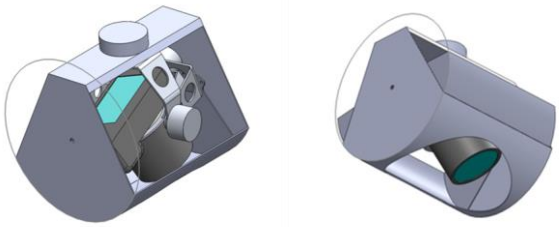


What we want



Roll Ω, Pitch Φ, Yaw, K compensation





Gyro-stabilised
Active Gimbal

Hardware and Software solutions to achieve accurate mapping

- roll, pitch and yaw solved with the use of a Gyro-stabilised Active Mount (GAM) built into the drone
- Frames are near-nadir and have almost no crab
- Integrated with the Flight Management Software
- Record remaining small amounts of Ω, Φ, K with the GAM
- Results: images in nadir position with better than 1 degree of accuracy
- Imagery is immediately available for human 3D stereo viewing
- Reduction or elimination of angular image motion

Dynamically Stabilised Active Mount

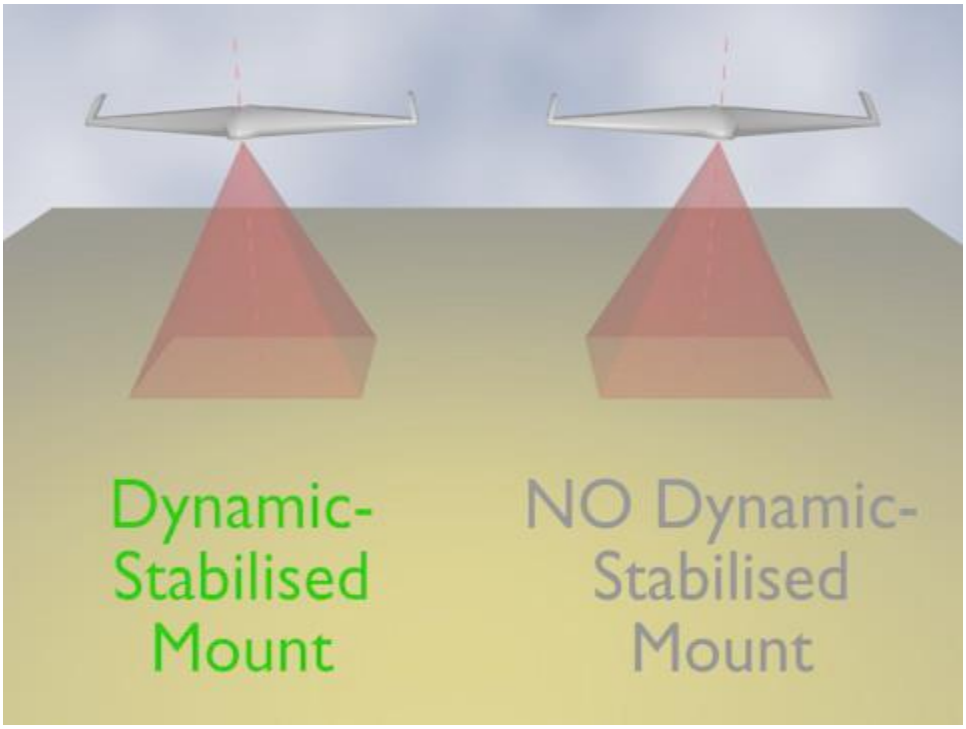
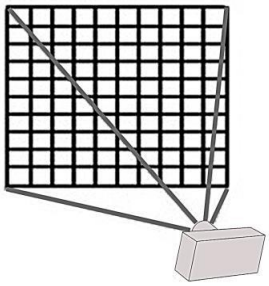
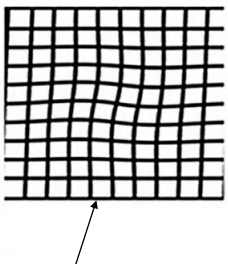
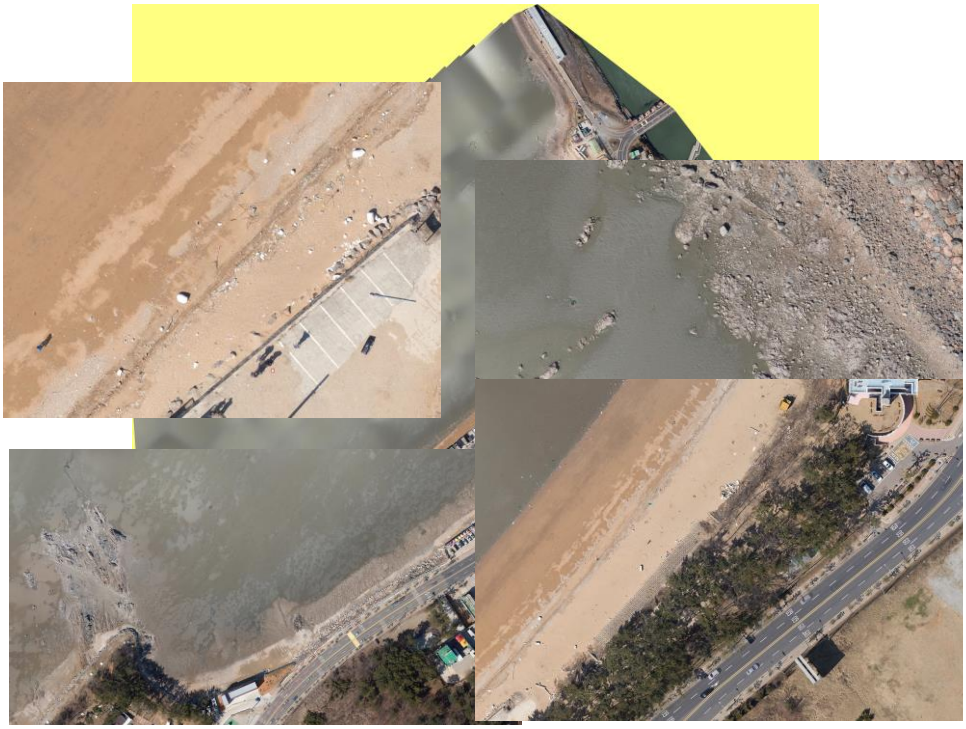


Image with and without Gyro-Stabilised Active Mount





Warped and skewed image without the GAM



Cameras

Small UAV payload weight & flight endurance dictate cameras

- Digital cameras, small, light and cheap (but tragic for accurate photogrammetric mapping)
- Photogrammetric Cameras - expensive and heavy
- Commercial Off The Shelf (COTS) Digital cameras
  specify for the drone with Photogrammetric fundamentals

Fundamentals to specify for the CTOS camera

Largest Field of View (FOV) - Larger the FOV the greater the effective ground coverage

- Large ground coverage = less flight runs to cover the same area of interest (AOI)
- Less images to match and process
- Increases the accuracy of the photogrammetry

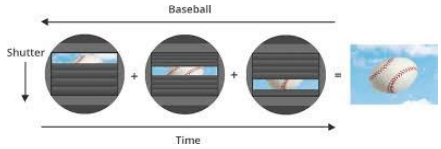
Larger Sensor and Pixel size

- full frame sensor 36mm x 24mm, bigger image sensors = better quality photo's

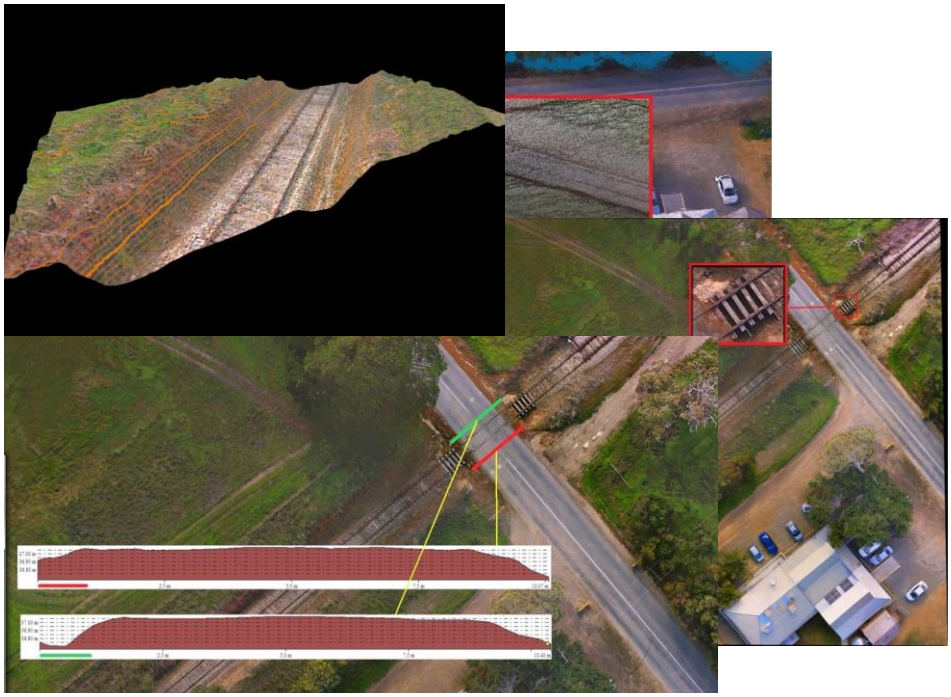
Fundamentals to specify for the CTOS camera

Shutter system, Focal plane v's Leaf

- Focal plane, curtain with a slit travels across the digital sensor, not suitable for photogrammetry



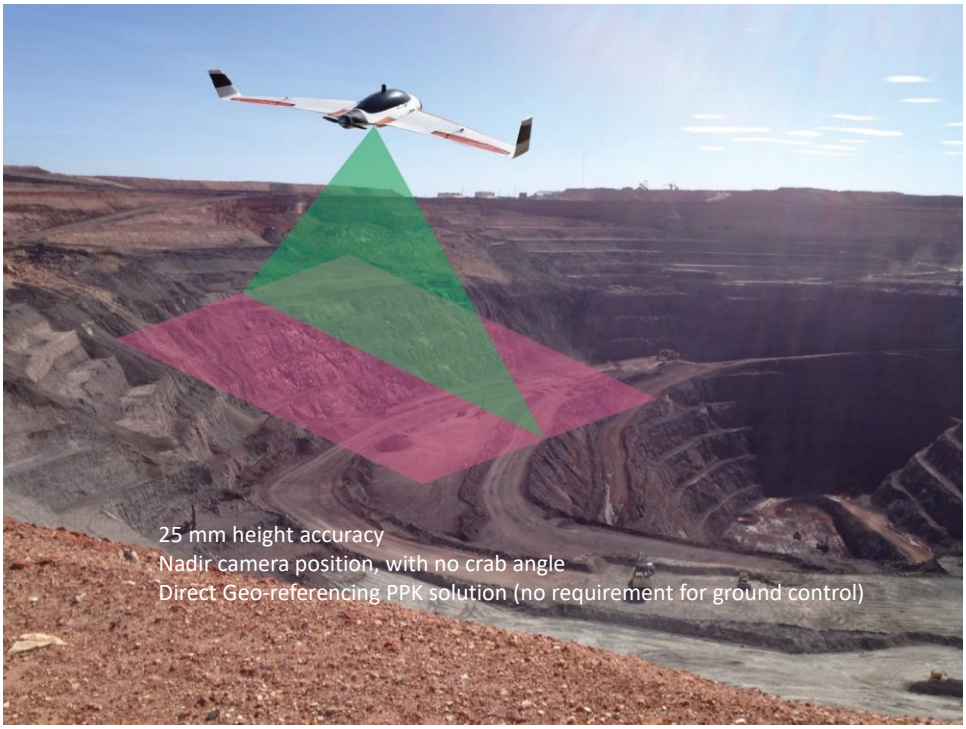
- Leaf shutter



- Natural Colour

Understanding the Digital Camera's high dynamic range

14 bit digital image technology allows us to get more detail out of areas that are traditionally featureless



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Summary

- Drones systems designed from first principles as accurate Photogrammetric systems
- Dynamic Stabilised Active Mounts
- 20, 24, 36 Mp calibrated full-frame CTOS (Prosumer) camera sensors
- Direct Georeferencing PPK system
- 20mm horizontal (X & Y), 25 mm vertical (Z) accuracy

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Acknowledgement

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