FIG WORKING WEEK 2017

Helsinki Finland

29 May - 2 June 2017

Željko Bačić, Danijel Šugar, Roko Grzunov:

Investigation of GNSS receiver's accuracy integrated on UAVs

TS02C: UAV and Photogrammetric Methods, Commission 5

Faculty of Geodesy
University of Zagreb

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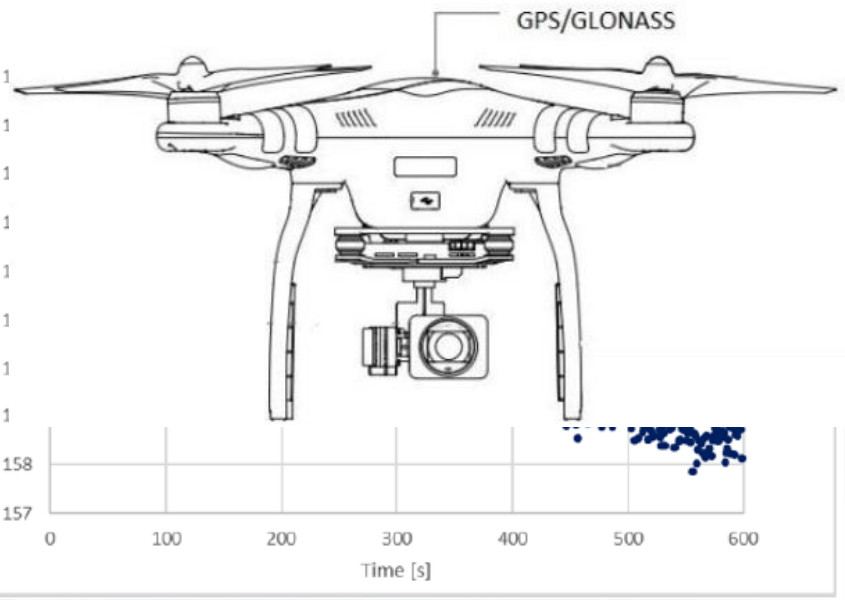
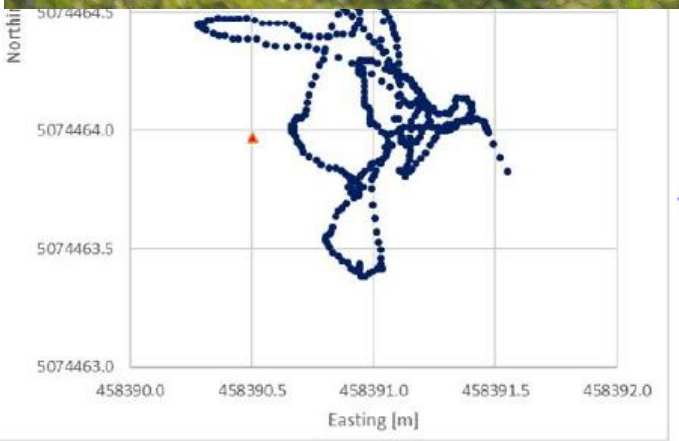
Introduction:

- surveying product: Digital Orthophoto, DSM, 3D models, DTM... are related to the accuracy attainable by GNSS,
- manufacturers of UAVs rarely provide detailed information about GNSS receiver's accuracy,
- Which is the real accuracy attainable by GNSS receivers?

Static test: DJI Phantom 3 Professional (10 minutes, 1 Hz)





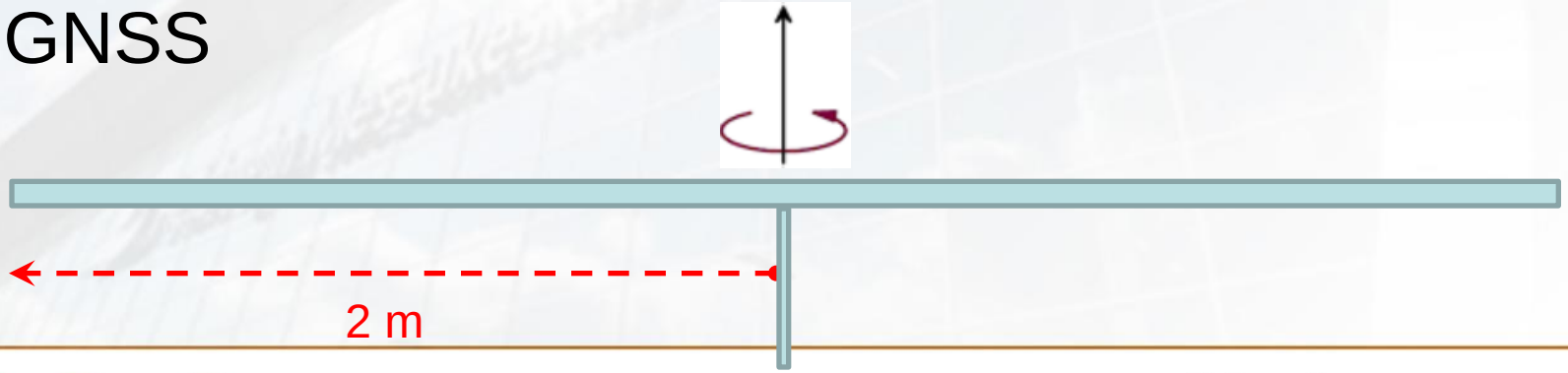
$\Delta_E = 0{,}43$ m, $\Delta_N = 0{,}39$ m, $\Delta_h = -4{,}81$ m.

$\sigma_E = \pm 0{,}23$ m, $\sigma_N = \pm 0{,}52$ m, $\sigma_h = \pm 0{,}84$ m.

$range_E = 1{,}27$ m, $range_N = 2{,}23$ m, $range_h = 3{,}58$ m.

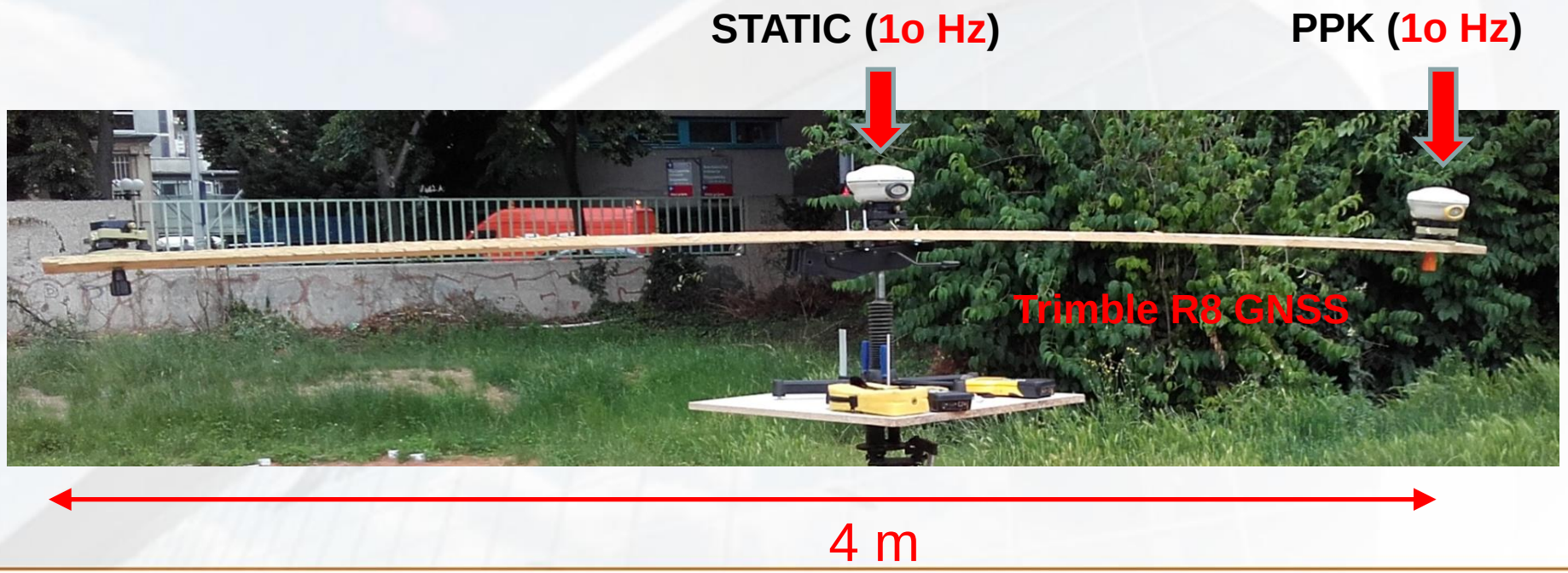
Kinematic test:

- We need a platform!
- Platform that meets two basic requirements:
  1) Movement on rigorously controlled trajectory with known position (orientation) in every moment,
  2) Dimensions of the platform should be, significantly larger than the accuracy provided by GNSS



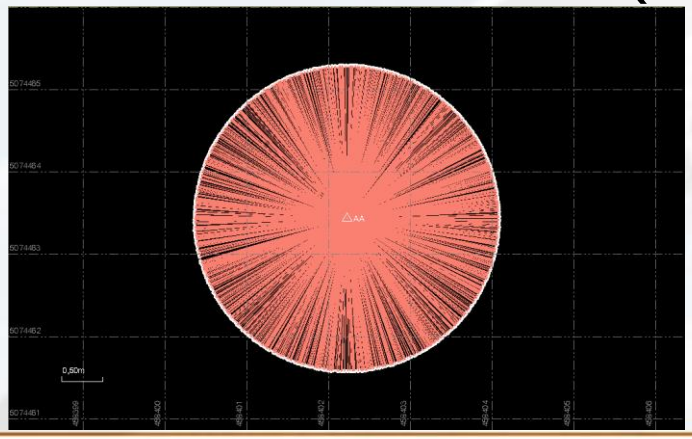
Kinematic test: How to obtain coordinates?

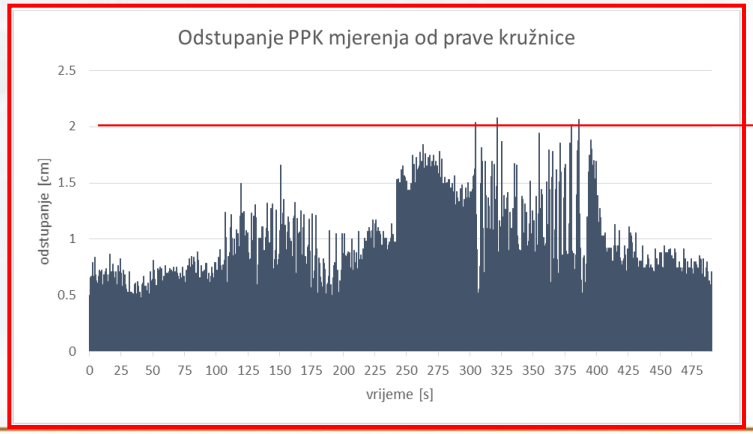
1) ~~CROPOS (NRTK, VRS), f(max) = 1 Hz~~
2) ~~PPK + CROPOS (RINEX), f(max) = 1 Hz~~
3) STATIC (10 Hz) + CROPOS (RINEX, 1 Hz) & STATIC (10 Hz) + PPK (10 Hz) ✓



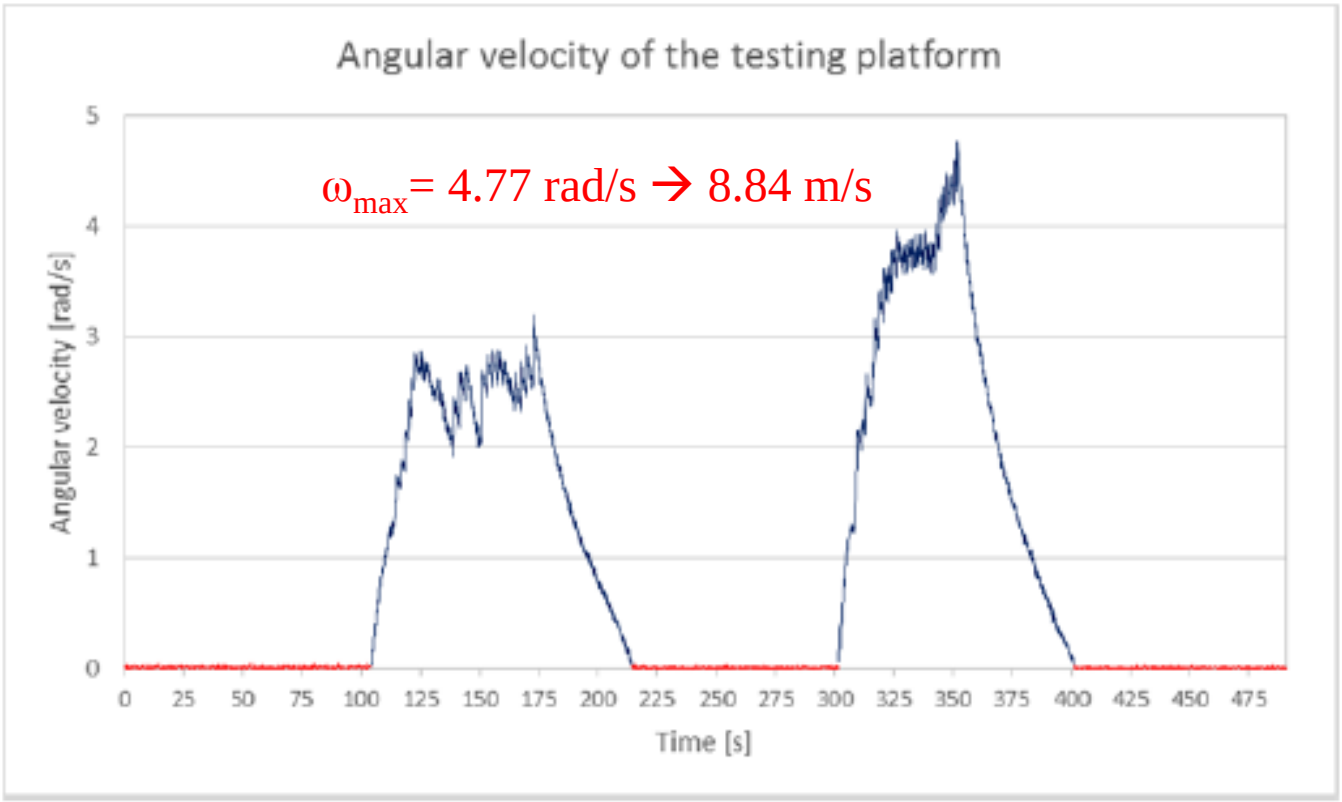
Kinematic test:

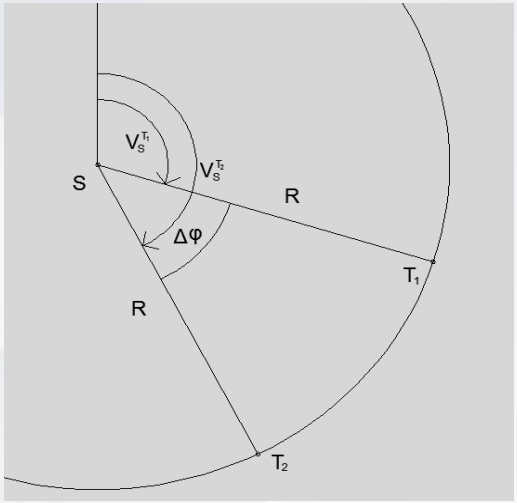
- PPK: 8 minutes (OTF) + 8 minutes





Kinematic test: angular velocity



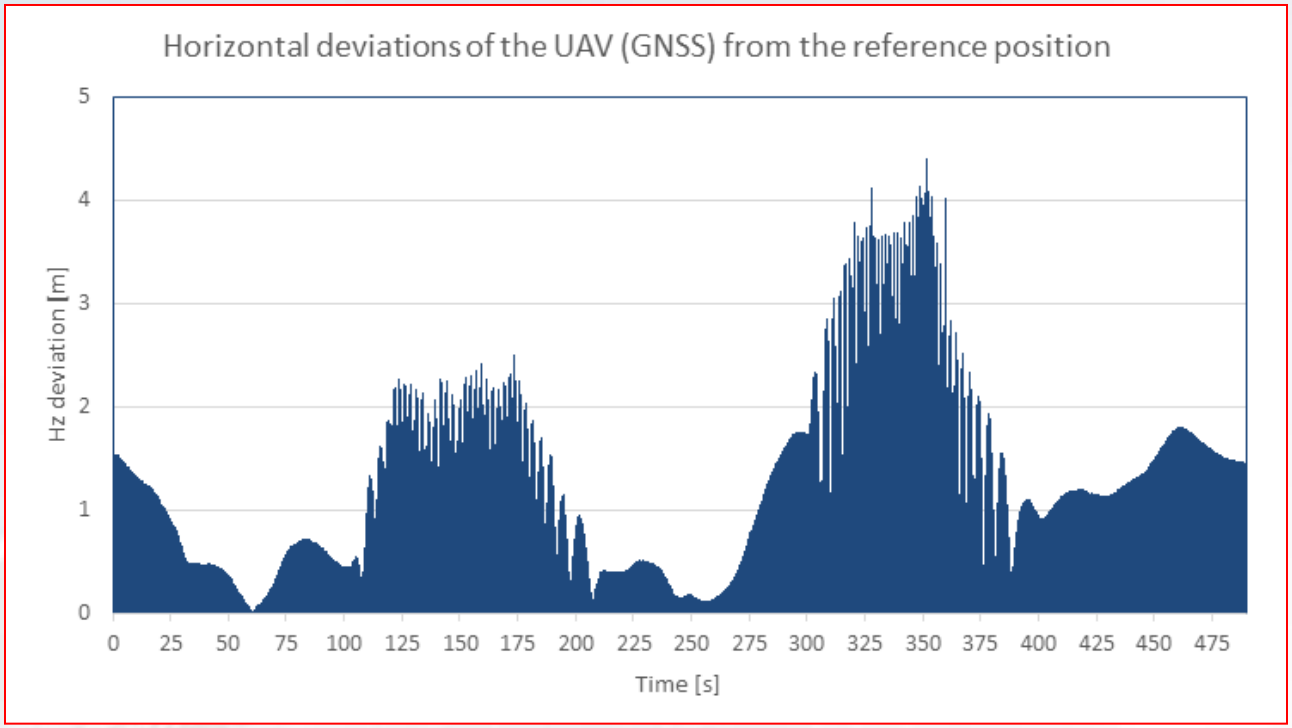


$$\Delta\varphi = v_S^{T_1} - v_S^{T_2}$$

$$\omega = \frac{\Delta\varphi}{\Delta t}$$

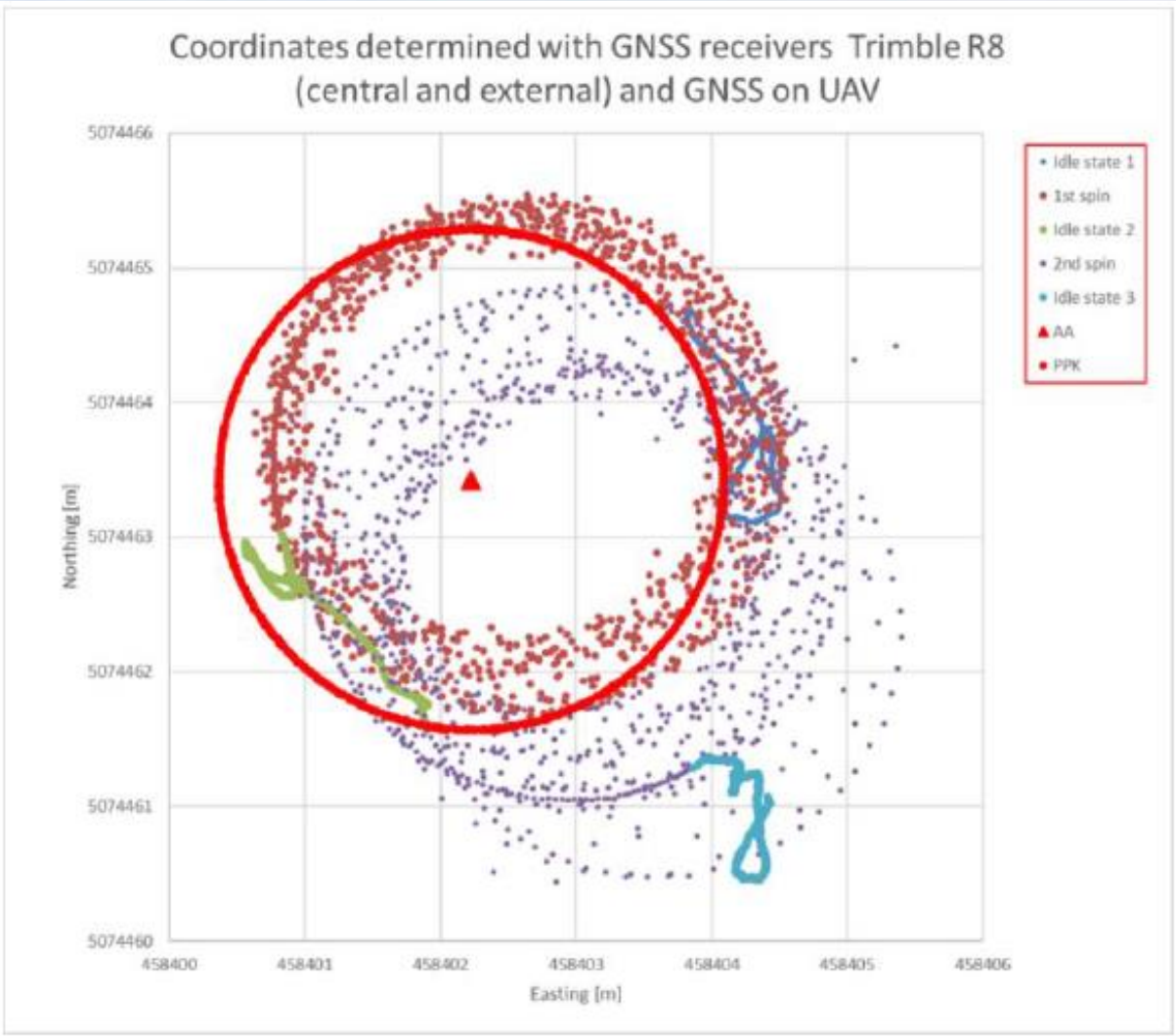
$$v = \omega * R$$

Kinematic test:

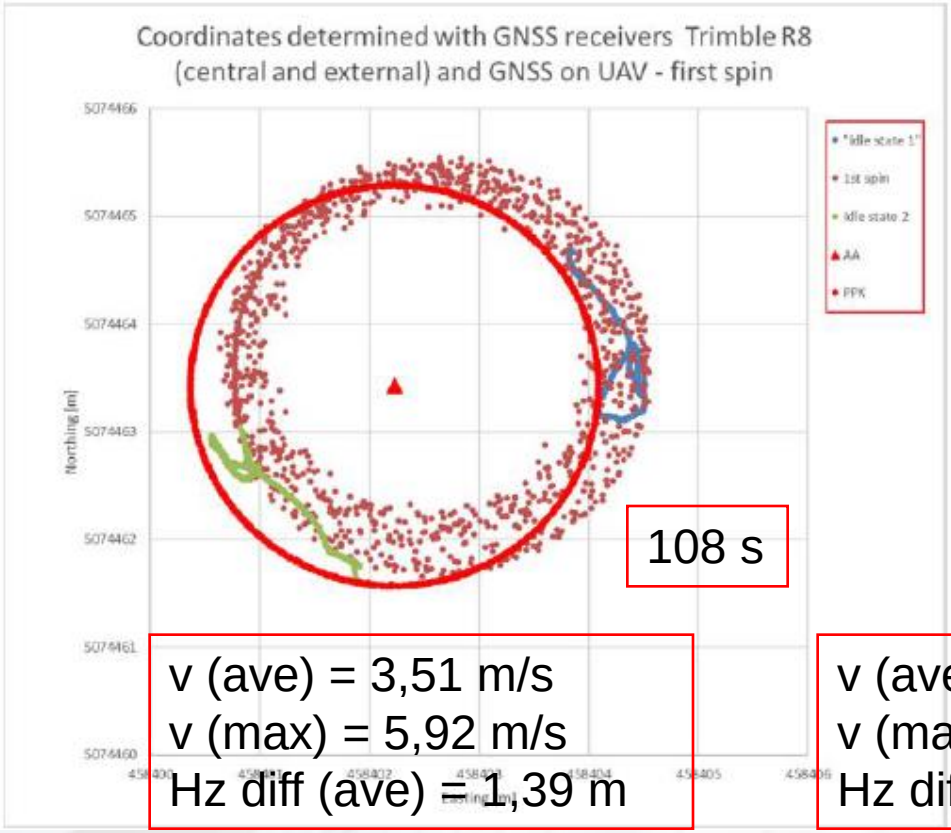


- Static test: Horizontal accuracy < 2 m
- Kinematic test: Horizontal accuracy < 4 m
- For the production of 3D models, DSM... → GCPs are required

Kinematic test:

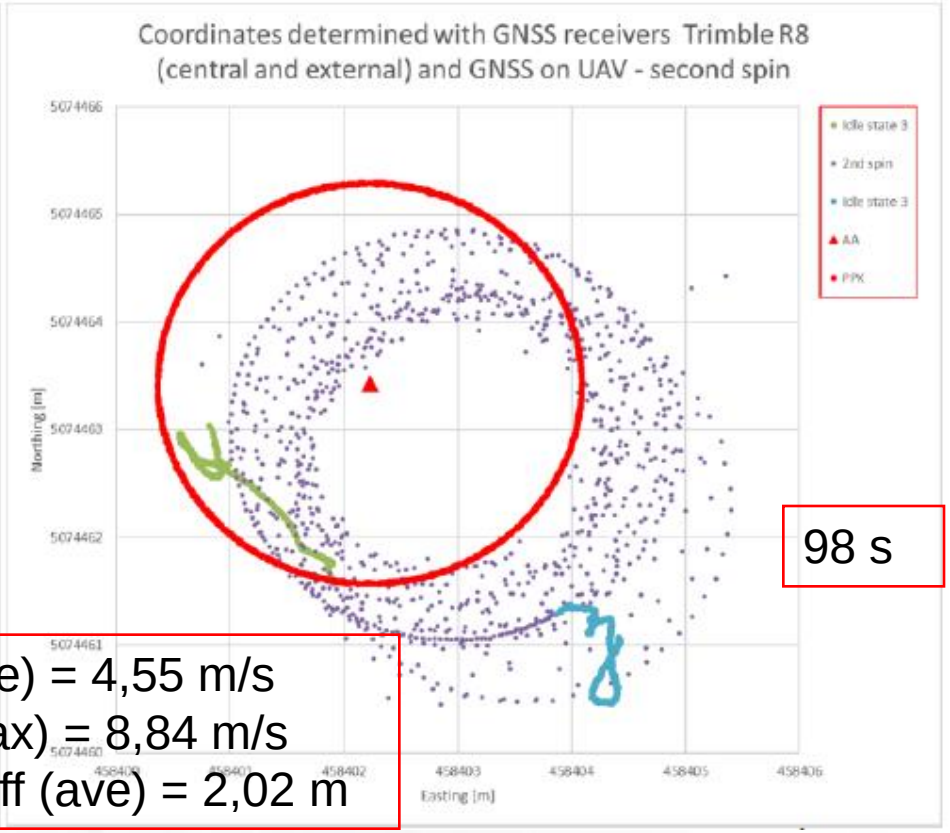


Kinematic test:



108 s

v (ave) = 3,51 m/s
v (max) = 5,92 m/s
Hz diff (ave) = 1,39 m



98 s

v (ave) = 4,55 m/s
v (max) = 8,84 m/s
Hz diff (ave) = 2,02 m

- stopping the UAV during the image shooting has multiple adventages: stabiliy, low vibrations, improved coordinstes)

Conclusions:

- testing platform has revealed:
  - Hz accuracy at 1 m – level (2 m) (static)
  - Hz position accuracy down to 4 m (kinematic)
- considering the revealed accuracy comes clear why the aerial survey should rely on GCP
- accuracy improvement by RTK
- even UAV equipped with RTK are suitable for testing on platform
- in addition to GNSS, other sensors could be tested (IMU)

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