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MISB EG 1206.1 – Video SAR Metadata Overview

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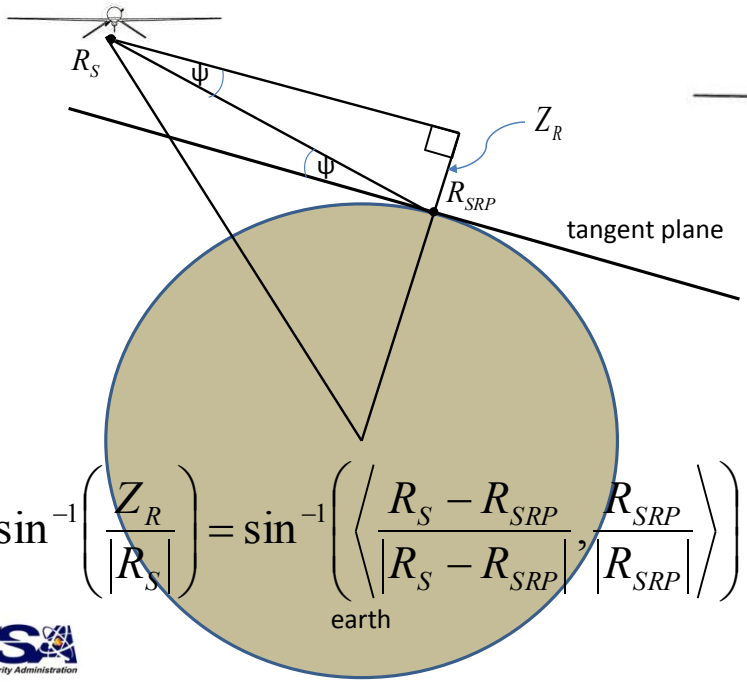
Introduction

- June 2012 MISB meeting – proposed metadata for video SAR/CCD to facilitate basic geospatial measurements.
- Oct 2012 – draft of a video SAR/CCD metadata *Engineering Guideline* (*EG 1206.1*).
  - Defines how video SAR metadata can be computed from existing metadata whenever possible.
  - Proposed new metadata adheres to pre-existing NITF Tagged Record Extension (TRE) definitions.

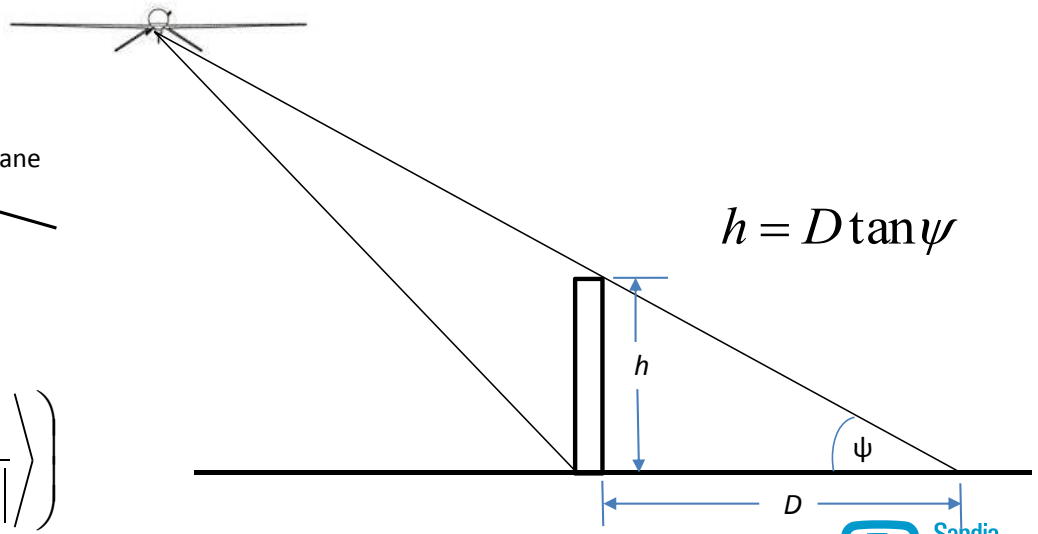
Metadata	Exploitation Benefit	Computable from Metadata?
Grazing angle	Estimate heights of objects in captured frames	Yes
Squint angle	Compute scene geometry, range/ shadow/ layover directions	Yes
Imaging plane	Correct distance measurements	No
Resolution	Indication of expected RNIIRS quality, can compute other parameters	No
Pixel/Image Size	For measuring distances in SAR/CCD frames	No
Range direction	For correctly measuring shadow lengths for height estimation	Need North direction
Aperture angular extent	Knowledge of frame angular extent for increased situational awareness	Xrange res+RF info.
Aperture Duration	Knowledge of latency for situational awareness	Xrange res or apert. length
CCD reference time	Gives a time interval for occurrence of an observed activity	No

Grazing Angle

- Required to estimate height of objects in video SAR/CCD frames.
- Angle between the LOS vector and plane tangential to geoid at SRP.
- Define using NITF CMETAA TRE definition.

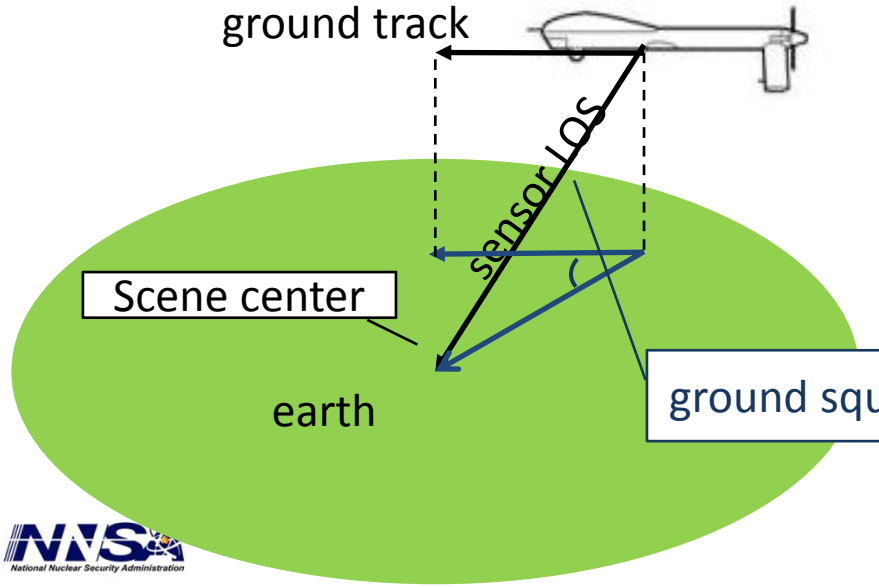


$$\psi = \sin^{-1}\left(\frac{Z_R}{|R_S|}\right) = \sin^{-1}\left(\left\langle \frac{R_S - R_{SRP}}{|R_S - R_{SRP}|}, \frac{R_{SRP}}{|R_{SRP}|} \right\rangle\right)$$



[Ground] Squint Angle

- For determining range/shadow directions for height estimation.
- Angle between the ground track vector and sensor LOS vector when projected into plane tangential at the geoid.
- Define using NITF CMETAA TRE definition.



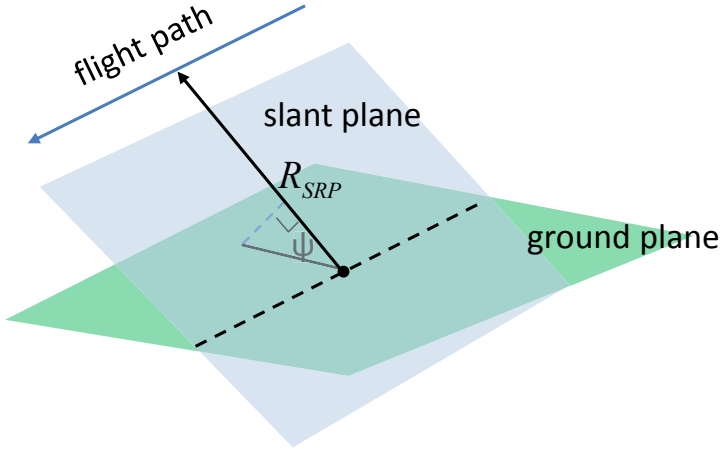
$$R_{S,g} = R_S - \langle R_S, u_{R_{SRP}} \rangle u_{R_{SRP}}$$

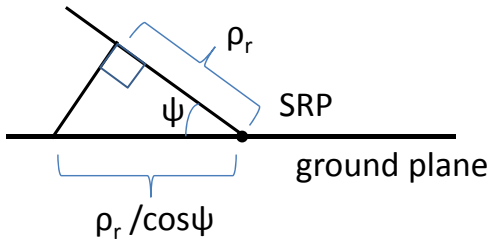
$$V_{S,g} = V_S - \langle V_S, u_{R_{SRP}} \rangle u_{R_{SRP}}$$

$$\alpha_g = sign * \cos^{-1}\left(\left\langle -\frac{R_{S,g}}{|R_{S,g}|}, \frac{V_{S,g}}{|V_{S,g}|} \right\rangle \right)$$

Imaging Plane

- Correct for range foreshortening effects for distance measurement accuracy.
  - Recommend ground projection.
  - A structure's dimensions appear the same regardless of aspect angle.
- Define using NITF CMETAA TRE definition.





Resolution

- Gives expectations on image quality in terms of RNIIRS.
- Theoretical resolutions.
  - Range: $$\rho_r = \frac{K_r c}{2B}$$
  - Cross range: $$\rho_a \approx \frac{K_a R_S \lambda_C}{2L \sin \alpha_{dc}} \approx \frac{K_a \lambda_C}{2\Delta\theta}$$
- Define using NITF CMETAA TRE definition.

Pixel & Image Size

- Needed to measure Euclidean distances in video SAR/CCD frames.
- SAR analogy to FOV for EO/IR.
- Define using NITF ACFTB TRE and NITF 2.1 image subheader.

Range Direction

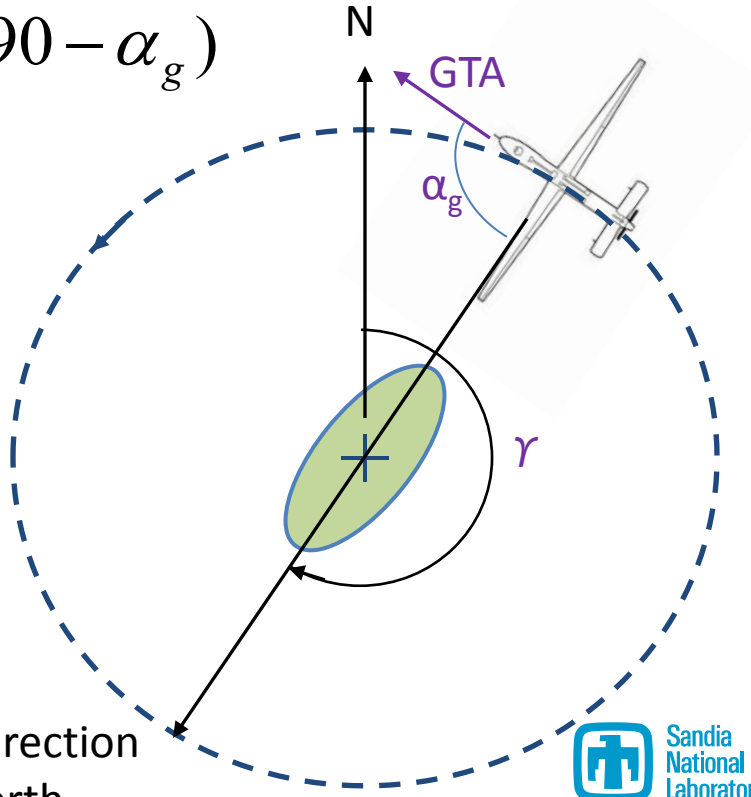
- **Range direction is defined with respect to True North.**

  Left looking: $\gamma = GTA_{SRP} + (\alpha_g - 90)^*$

  Right looking: $\gamma = GTA_{SRP} + (90 - \alpha_g)$

- **True North direction is defined with respect to the image (for stills, CG_NORTH from NITF 2.1 CMETAA TRE).**

*Uses NITF CMETAA definition for squint (CG_GPSAC)

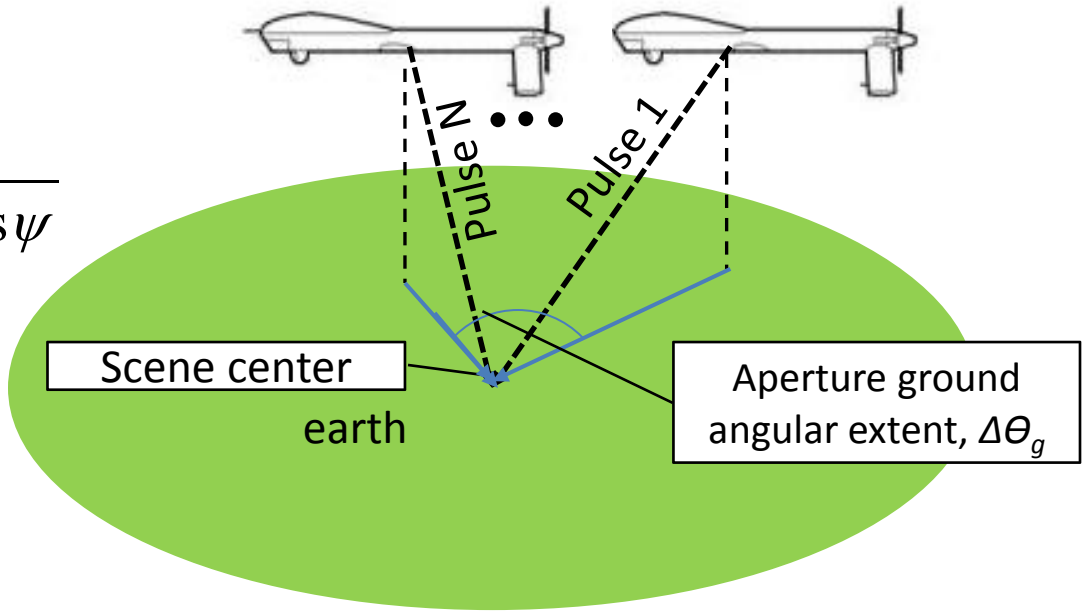


range direction w.r.t. North

Aperture Angular Extent

- **Knowledge of scene azimuthal coverage for a *single video frame* increases situational awareness.**
- **Cannot be currently computed due to incomplete metadata.**

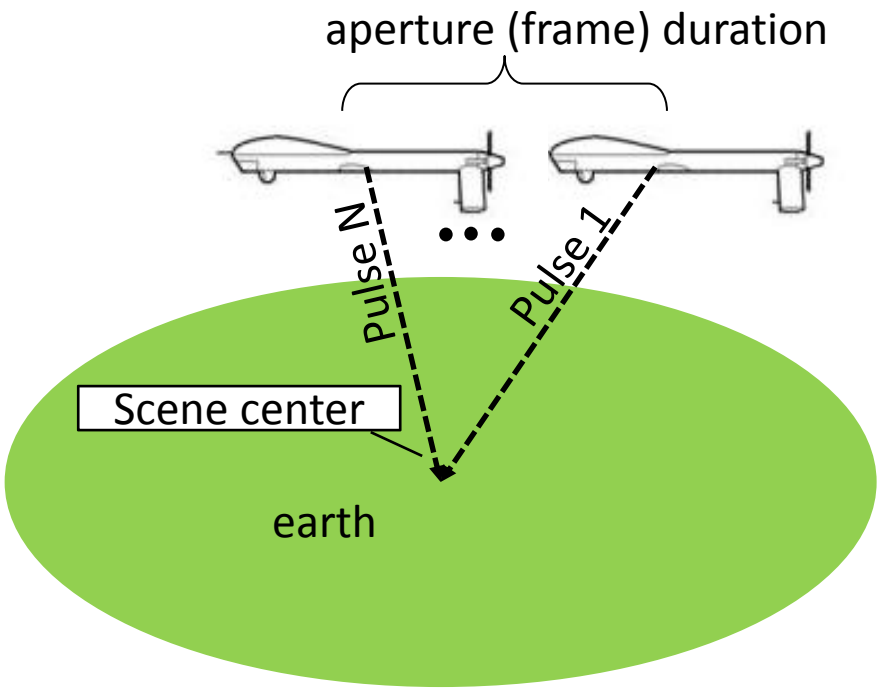
$$\Delta\theta_g \approx \frac{K_a \lambda_c}{2\rho_a \cos\psi}$$



Aperture Duration

- **Knowledge of aperture collection time gives situational awareness of near real-time latency.**
  - **Latency is cross-range resolution dependent.**
- **For still SAR images, defined as WF_CDP in NITF 2.1 CMETAA TRE.**

$$T_a = \frac{|R_S|\Delta\theta}{|V_S|\sin\alpha_{dc}}$$



CCD Reference Timestamp

- Gives a time interval on the occurrence of an activity observed in the CCD motion imagery.
- No MISB equivalent metadata currently available.