

Digital Elevation Modeling using TerraSAR-X Radargrammetry

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Overview

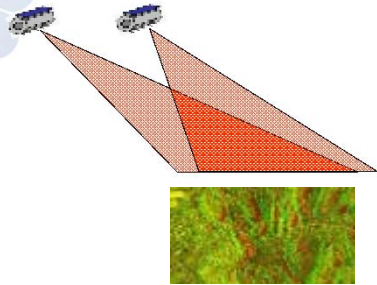
- Introduction
- Radargrammetry
- Applications
- Conclusions

DEM generation by TerraSAR-X

Extract elevation information using TerraSAR-X:

Radargrammetry (Stereo 3D reconstruction)

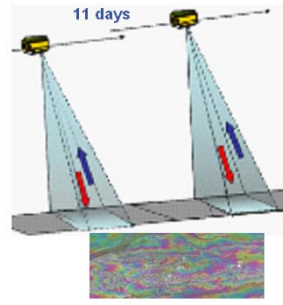
<11 days



Utilization of two intensity images with different acquisition geometry

SAR Interferometry (repeat pass InSAR)

11 days



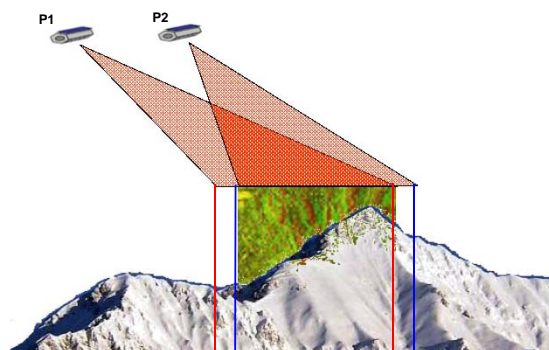
Utilization of the phase difference of two images with the same geometry

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TerraSAR-X Radargrammetry

- TerraSAR-X StripMap data
- Pair with different incidence angle
- high accurate orbit information
- epipolar matching of same pixel in both images



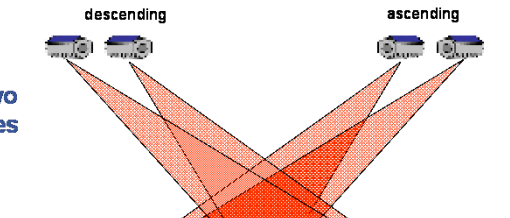
area of acquisition 1
area of acquisition 2
overlap area = area of DEM generation

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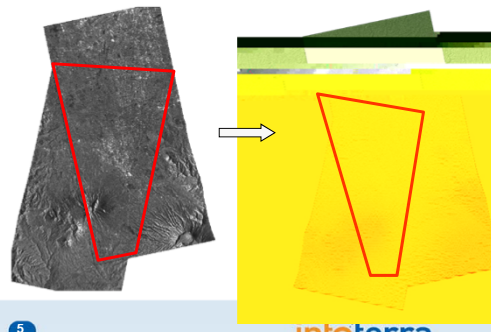
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TerraSAR-X StripMap data acquisition and DSM extraction

- To overcome shadow and lay over effects: acquisition of two TerraSAR-X stereo-pair images from both looking directions (ascending and descending)



→ Asc/Desc-Merge



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TerraSAR-X Stereo DSM Acquisition Parameter

Acquisition Requirements

- Acquisition Mode: StripMap
- Disparity Angle: $17^\circ - 23^\circ$ ($15^\circ - 25^\circ$ possible)
- Incidence Angle Range: $20^\circ - 60^\circ$
(far range preferred → minimize layover effect)
- Calculation on slant-range data
- Temporal spacing between acquisitions (pair): low

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TerraSAR-X Stereo DSM Acquisition Parameter

Depending on relief

- Larger disparity angle for flat terrain
 - Smaller disparity angle for strong relief
- Trade off between geometric robustness and layover/shadow effects

Seasonal & land cover effects

- Snow coverage generally reduces matching accuracy due to missing structure
- Agricultural and forest areas: small temporal baseline
- Desert: small temporal baseline; larger disparity angle especially in flat terrain areas
- Areas with snow and ice coverage: spring or autumn; wet snow reduces energy of backscatter signal

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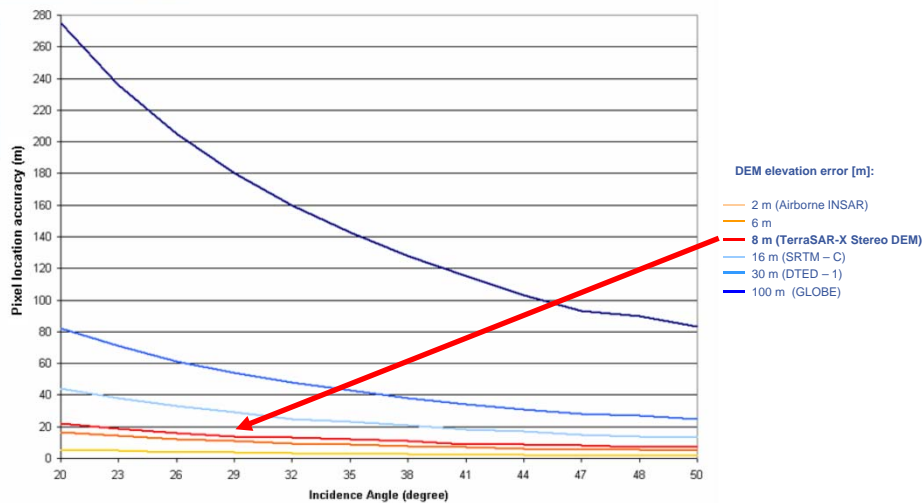
Applications

- Orthorectification
- Topomapping
- ...

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Connection between DEM and pixel location accuracy



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Conclusions

- **Radargrammetry vs. InSAR**
 - Changes in backscatter (e.g. in vegetated areas) not so susceptible for radargrammetry
 - Data acquisition for one area of interest faster for radargrammetry due to availability of different orbits
- **Data acquisition cloud and daylight independent**
- **Fast data processing with TerraSAR-X data adapted epipolar matching algorithm**
- **Combination of TerraSAR-X derived DSM and imagery well suited for many applications like Topomapping**

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