What is the best improvement of PALSAR-2/ScanSAR products to the future success of JJ-FAST or other projects using ScanSAR mosaic?

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Jan. 29-31 2018
KC meeting in Tokyo
Contents

• General of the PALSAR-2/ScanSAR processing
• Specan/Full Aperture
• Resolution Upgrade – comparison
• Future upgrade
• Conclusion
Back Ground

- PALSAR-2/ScanSAR is the driving force for monitoring forest at MOSAIC production and JJ-FAST detections.
- Currently 50m spacing was selected for the production.
- **Specan** is currently selected for the processing algorithm because of the “processing speed and image quality”.
- In order order to maximize the sensitivity for detecting the forest, optimizing the processing parameters, i.e., no. of looks, etc. needs to be performed.
- This presentation shows one examples for this trial.
- What is the best way for improving the image quality?
PALSAR-2 Images (ScanSAR)

ScanSAR: Amazon Rondonia area (HH)

Area: Hokkaido
Bandwidth: 28 MHz
Mode: W(5 scans)

Shimada 2015 APSAR
Imaging and calibration Strategy (i.e., Range Doppler)

SB  
UB  
HB  
WB  
VB

Fr-Rx  
Br-Rx  
RX

I+jQ  
I+jQ  
I+jQ

RC

UD+APC

Reconst filter

AC(Specan for WB and VB)+Migration +Elevation-Antenna correction

Output

1.5
2.1

RC: Range compression
Fr: Forward Receiver
Br: Backwar receiver

PolCal(HBQ)

R-cal  
G-Cal

Antenna Elev
Antenna azimuth

AGC for SB, UB, HB, FB
MGC for WB & VB

Chirp eval.

Phase determ.
SCANSAR multi looking (Specan method)

\[ \frac{f_{prf}}{f_{dd}} v_g \]

\[ N_{fft} \]

Burst 1

Burst 2

Burst 3

Range direction

SST

Geo-plane

Image plane

Chirp-z FFT, FFT are used.
Telemetry interpretation

Doppler analysis

Interference analysis and correction

Range correlation

Range Curvature

De Ramping

Look summation

SAR image

Specan

Full Aperture

+Data allocation in azimuth
+Azimuth correlation
+Look summation
ScanSAR imaging block diagram

Resolution

Unfocused burst

Focused burst on the ground

final image on the ground

\[ x = v_g \cdot \left\{ T_{SCAN} \cdot i + \frac{f_{PRF}}{f_{DD} \cdot 2} \cdot \frac{f_{PRF}}{f_{DD} \cdot N_{az,k}} \cdot j_i \right\} \]

\[ = v_g \cdot \left\{ T_{SCAN} \cdot (i - 1) + \frac{f_{PRF}}{f_{DD} \cdot 2} \cdot \frac{f_{PRF}}{f_{DD} \cdot N_{az,k}} \cdot j_i - 1 \right\} \]
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<th>swst</th>
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<th>nolines</th>
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**Notes:**
- ndelay: Number of delays
- pulses at the 5th beam: Sometimes varies to adjust the location of the bursts.
## Resolution Comparison between ScanSAR and Full Aperture

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<th>Method</th>
<th>Range resolution</th>
<th>samples</th>
<th>Azimuth resolution</th>
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<td>Specan</td>
<td>$c/2/Bw/sin^q$</td>
<td>15m</td>
<td>$f_{PRF}/f_{DD}/NP*^v$</td>
<td>&gt;42m</td>
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<tr>
<td>Full Aperture</td>
<td>$c/2/Bw/sin^q$</td>
<td>15m</td>
<td>$L/2*NS$</td>
<td>~25m</td>
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</table>

$F_{PRF} >= 2200\text{Hz}$, $f_{DD} <= -590\text{Hz/s}$, $NP = 370 \sim 500$, $v = 6700\text{m/s}$, $Bw = 14\text{MHz}$

NS: Number of scans

$f_{DD}$: Doppler chirp frequency rate (Hz/s), NP: Number of pulses, $v$ : the ground speed.

L: antenna azimuth length ($\sim 10\text{m or 12.5 m}$)

Q is the incidence angle
## Comparison Table

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Beam illumination

Satellite moving direction

SPECAN

HH

HV
Beam illumination

Satellite moving direction

Full Aperture Processing
New gain assignment (25 dB HH and 20 dB HV): Specan alogorism used, and Sigma-SAR
Full Aperture Processing
Comparison of the image

• 8 image chips over Specan and Full Aperture
• Two test areas (Urban and river side area) and Filed area
Site 1 (Rice Field area)-HH
Site 1 (Rice Field area)-HV
Site 1 (Urban and river side area)-HH
Site 1 (Urban and river side area)-HV
Proposed update
Conclusion

• FA gives better image quality and resolution than Specan method (needs to be implemented for ALOS-2 future products), while

• FA needs 3~4 times computing load more than SP.