Scattering property based adaptive filtering of dual polarization Sentinel-1 data for PSI application

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• PSI can achieve a dense network of measurement points in urban regions but in rural areas this cannot be fulfilled.

• To increase density of measurement points Distributed scatterers (DS) can be exploited (Ferretti et al 2011).

• This requires adaptive filtering of DS by maintaining PS candidates.

• The objective of this presentation is to present a scattering property based adaptive filter to filter DS.

Polarimetric coherency matrix by assuming stationarity and ergodicity in time is given as

\[ T = \frac{1}{n} \sum_{i=1}^{n} k_i k_i^\dagger, \]

where \( k_i = \begin{bmatrix} S_{VV} & 2S_{VH} \end{bmatrix}^T \), \( i \in [1, 2, ..., n] \)

Cloude-Pottier target decomposition (Cloude and Pottier 1997) and Wishart distance classification was used to derive scattering class.

• Locally homogenous patches were generated by considering interconnected pixels within a n*n window.

\[
\begin{array}{cccccc}
V & V & D & S & S \\
V & V & S & S & V \\
V & V & S & D & D \\
V & V & S & D & D \\
S & V & V & D & D \\
\end{array}
\]

\[
\begin{array}{cccccc}
V & V & D & S & S \\
V & V & S & S & V \\
V & V & S & D & D \\
V & V & S & D & D \\
S & V & V & D & D \\
\end{array}
\]

S = Single bounce
D = Double bounce
V = Volume scatterers

• Isolated pixels are merged using the majority rule except for the brightest deterministic double bounce and single bounce class.

• QPS (Perissin and Wang 2012) method was implemented to estimate displacement

• 17 Sentinel-1A and 4 Sentinel-1B images
• VV and VH channels
• Acquired from August 2015 to April 2017
• Around the city of Enschede, the Netherlands
- Homogenous pixel patches identified within a window of 15x15
RESULTS

Unfiltered intensity image
Red: VV Green: VH Blue: VV+VH

Adaptively filtered intensity image
RESULTS

Unfiltered interferogram

adaptively filtered interferogram
RESULTS

1-μ/σ of amplitude

15x15 adaptively filtered average coherence
RESULTS

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PSC at full resolution: 12,183 and adaptively filtered interferograms: 70,450
Temporal coherence histograms
CONCLUSION

• This presentation showed scattering properties can be used to adaptively filter dual pol Sentinel-1A/B data for multi-temporal InSAR application.

• The proposed adaptive filtering method increased the number of candidate points by preserving point like scatterers while filtering extended radar targets.

• Displacement results derived from adaptive filtering showed good agreement with PSI.

• Further work may include verification of the derived displacement velocities with that of corner reflectors, differential GPS and other state of the art multi-temporal InSAR methods (SqueeSAR).
Thank you for your attention!