SAR Processing

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Outline

• Sonar Echoes
• Definitions
• What do we measure?
• Target detection
• Convolution
• Range compression
• Azimuth Compression
Sonar Echoes

Hello!
Some definitions

Swath

Range

Azimuth
What do we measure?

- At the satellite
  - Radar signal strength as a function of time
- After processing
  - Radar Cross Section per piece of dirt
Target detection
Target detection: Short pulse

- Power problem
  - We need a short pulse for resolution
  - We need a lot of power for detection
Target detection: Long pulse

- Power problem
  - We need a short pulse for resolution
  - We need a lot of power for detection
Target detection: Chirp

- Can go from low to high or high to low frequency
- Can be much more complicated
Target detection: Chirp pulse
Convolution

- Run simulation
Convolution: Constructive interference

- Receive
- Convolution
- Transmit
Convolution: Destructive interference

- Receive
- Convolution
- Transmit
Convolution

- Receive
- Convolution
- Transmit

SAR Processing
Range Compression

- Convolve the received range signal with the chirp you sent out.
- Range line looks similar to that of a short pulse – We have “compressed” the chirps in the signal to short pulses.
Azimuth: Real Aperture Radar

- Good resolution in range, poor resolution in azimuth
Azimuth: The Doppler effect
Azimuth compression

- Carl Wiley, in 1951, observed that two point targets at different azimuth positions, will have distinct Doppler frequency shifts. [Curlander, McDonough, 1991]
- We can compress the pulse in azimuth in the same fashion we compressed it in range.
- Convolve an azimuth line with the azimuth reference function:
Synthetic Aperture Radar

- Raw data
- Range compressed
- Azimuth compressed
Questions?

Image from ESA’s website at http://ravel.esrin.esa.it/images/EarthObservation/corv_257.jpg