WiBAR: Wideband Autocorrelation Radiometry

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How much water is stored in the seasonal snow pack?

- Billions of people around the world depend on snowmelt for their water.
- We don’t yet have a reliable way to measure the storage of water in the snow pack globally.
- The remote sensing community has not yet settled on the optimal combination of approaches for this problem (eg. NASA SnowEx).
- WiBAR is another tool:
  - microwave, so all-weather
  - passive, so low power, thus low cost
  - deterministic, so no algorithm calibration.
WiBAR measures Planck coherency

- WiBAR measures coherent effects of microwave emission, which reveals the thickness of low-loss slabs, such as snow on the ground or lake ice.

- This project demonstrates:
  - that the coherent signal exists for snow (ice already proven)
  - a novel receiver architecture for rapid measurement
Evidence of coherent emission from snow

- Cold days, dry snow: stronger signal
- Warm days, wet snow: weak or no signal

Expected range of lags given the ground truth

ACF (dB)

Lag time $\tau$ (ns)
One bit autocorrelator w/ 0.2 ns resolution

- Sub-Nyquist sampling w/ two clocks
- Clock periods differ by 0.2 ns
- Sample pairs span all lag times
A tunable comb filter for RFI mitigation

- WiBAR needs a wide frequency range, but not much bandwidth
- Microwave circuit of a Fabry-Perot interferometer
  - MW couplers serve as F-P mirrors
  - MW electronic phase shifter serves as F-P mirror spacing
Contributions

• Novel microwave receiver architecture for passive measurement of snow and ice accumulation that is sensitive to its macroscopic, not microscopic, properties

Next Steps

• Final integration and test of rapid acquisition hardware
• Validate RFI mitigation effectiveness
• Develop reduced SWAP receiver
• Go airborne, produce images & attempt disaggregation
Wideband
Autocorrelation
Radiometry

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