Analysis of Suomi NPP Cross-track Infrared Sounder (CrIS) Onboard Digital Filtering and Decimation



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CrlS Overview

- The Cross-track Infrared Sounder (CrIS) on Suomi NPP was launched 28 October 2011 •
- CrIS is an infrared Fourier transform spectrometer with 1305 spectral channels, and produces high-resolution, three-dimensional temperature, pressure, and moisture profiles. These profiles will be used to enhance weather forecasting models and they will facilitate improvements to both short and long-term weather forecasting



CrIS Water Vapor Map, 1580 cm⁻

CrIS Sensor Features

• Large 8 cm Clear Aperture Three Spectral Bands 3x3 FOVs at 14 km Diameter Photovoltaic Detectors in All 3 Bands 4-Stage Passive Detector Cooler Plane-Mirror Interferometer With DA Internal Spectral Calibration Deep-Cavity Internal Calibration Target Modular Construction

> **Physical Requirements** Volume 80 x 47 x 56 cm Mass < 98 kg



Onboard Digital Filtering and Decimation Analysis

Example: Sweep Direction Dependent Calibration Bias ('FOR Striping')

- CrIS interferograms are numerically filtered and decimated on-board (255 tap FIR filter, with complex coefficients).
- Neighboring CrIS FORs are opposite interferometer sweep direction •
- Interferometer sweep direction dependent calibration biases were observed. Investigation of this effect using • Diagnostic Mode data (no filtering and decimation) showed that it was associated with the onboard filtering and decimation.
- ITT Excelis designed a new filter optimized for the onboard FPGA application. •
- The onboard application of the original and revised filter is being replicated in the simulations presented here.

Analysis of FOR Striping Using Diagnostic Mode Data

- Compare sweep direction differences in ICT magnitude spectra for **Diagnostic Mode data**, **Diagnostic Mode** data with the numerical filter applied in Matlab, and Normal Mode data.
 - Diagnostic Mode (DM) Data: No onboard filtering or decimation
 - Normal Mode (NM) Data: Onboard filtering and decimation

Original Filter



The primary difference is image rejection; the pass band transfer function is nearly identical

New filter uploaded on Julian Day 109 at 16:41 UTC



Original Filter, Single Granule (SCRIS_npp_d20120418_t1530029)



sweep direction difference dependence on forward/reverse OPD misalignment and 'phasing' of filter and IGM

New Filter

Difference between ICT magnitude spectra of different sweep directions

Sweep Dir 0 ZPD Loc = 10517 Sweep Dir 1 ZPD Loc = 10521; ZPD loc diff: -4; dindex(1) = 255

	 DM with software NF, Dec offset: 00 NM data DM data, no Filtering or Decimation
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Difference between ICT magnitude spectra of different sweep directions

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New Filter, Single Granule (SCRIS_npp_d20120418_t1706029)





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Insignificant dependence on forward/reverse OPD misalignment and 'phasing' of filter and IGM