The Creonic Doppler Channel IP is a Doppler shift frequency (DSF) generator capable of introduce a shift frequency to samples as a phase offset. The IP was developed with the aim of allowing the performance evaluation of a low earth orbit (LEO) digital communication system. Unlike a software-based DSF generator, which might take several hours and even days for the stated purpose, a hardware-based DSF generator requires significantly less time. Run-time is reduced by several orders of magnitude.

Benefits

- Design-time configuration of the LEO altitudes range. Besides, the number of angles in the range from 0 to π rad, followed by the pre-calculation of sine and cosine functions. The IP uses the fast inverse square root algorithm, set up with three iterations to ensure accuracy.

- Low-power and low-complexity design.

- AXI4-Stream interface for easy integration.

- Available for ASIC and FPGAs (AMD Xilinx, Intel).

Performance Figures

- Symbol rate of 0.62 Gsmpl/s at 620 MHz.

- Latency of 78.98 ns at 620 MHz.

Channel Performance

The following figures depict:

- The behavior of the Doppler shift frequency (DSP) in the LEO heights of 500 and 1500 km.

- The mean absolute error of DSF.

- The mean percentage error of the DSF.

- The mean square error of DSF.
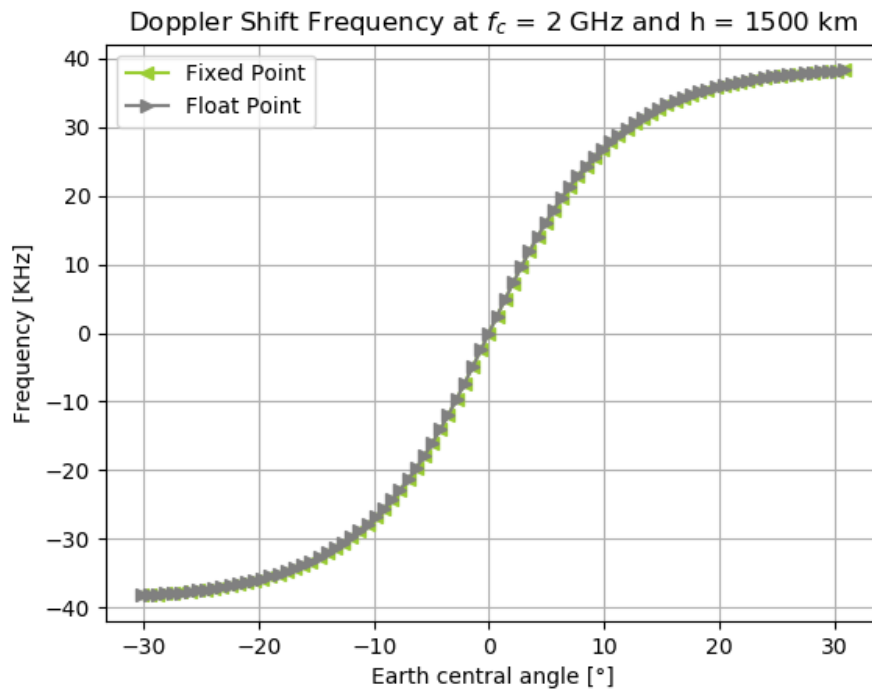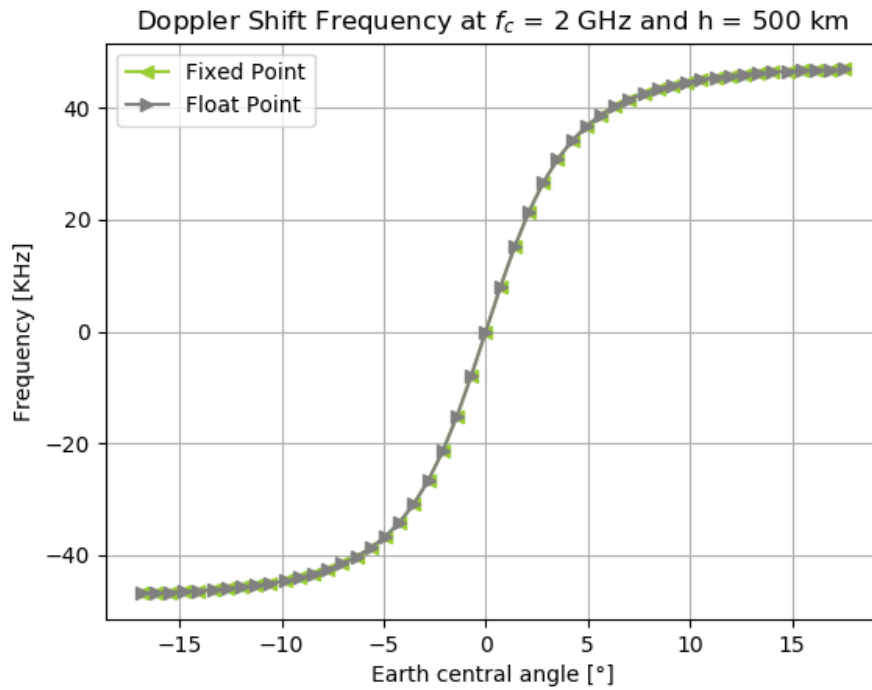
- The root mean square error of DSF.

Features

- Support for orbital heights (h) in the range from 200 to 2000 km

- Support for carrier frequencies (f_c) in the range from 137 to 2200 MHz

- Support for sample frequencies (f_s) in the range from 500 $Ksps$ to 500 $Gsps$

- Support variations in the initial elevation angle due to different latitudes, obstructions in the visibility region, and regulatory requirements
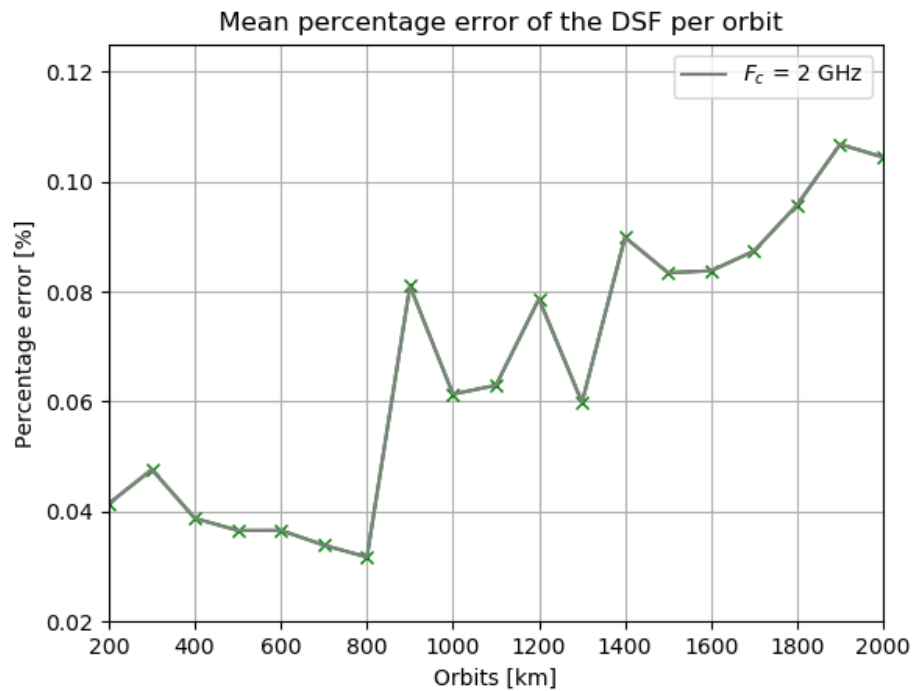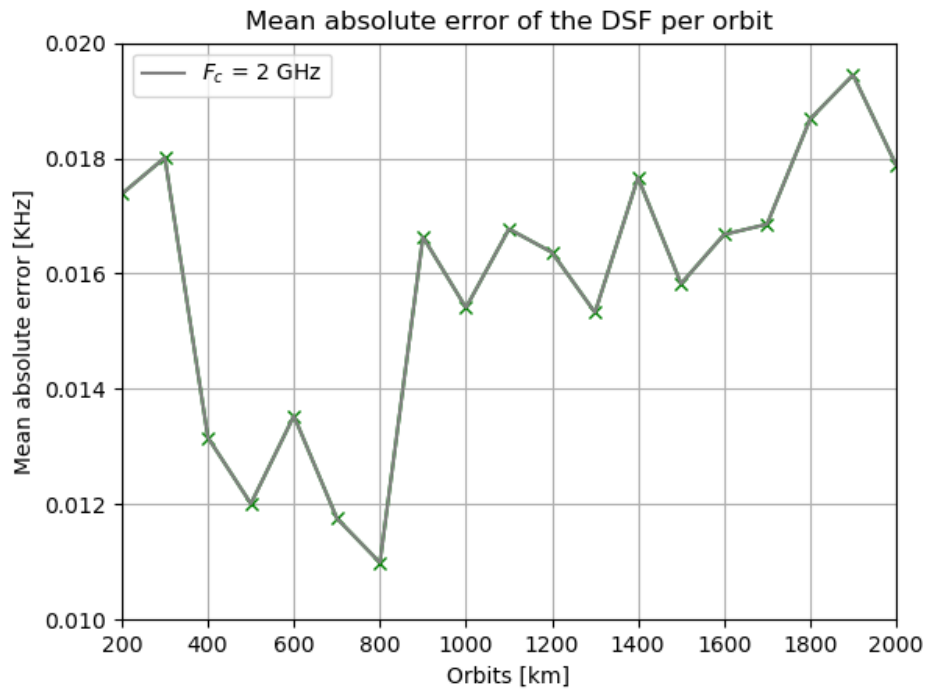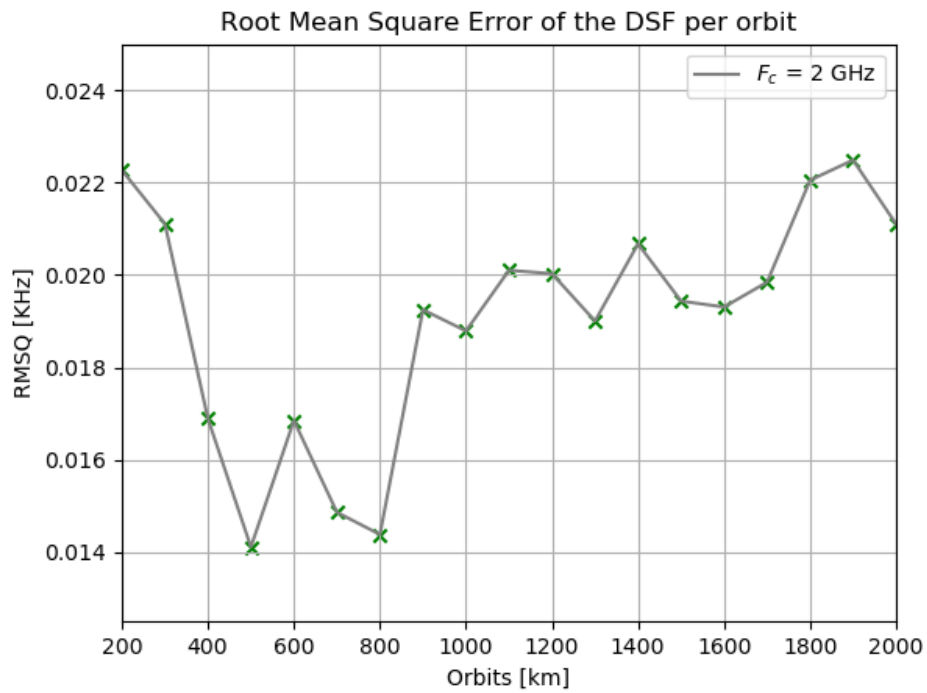
Applications

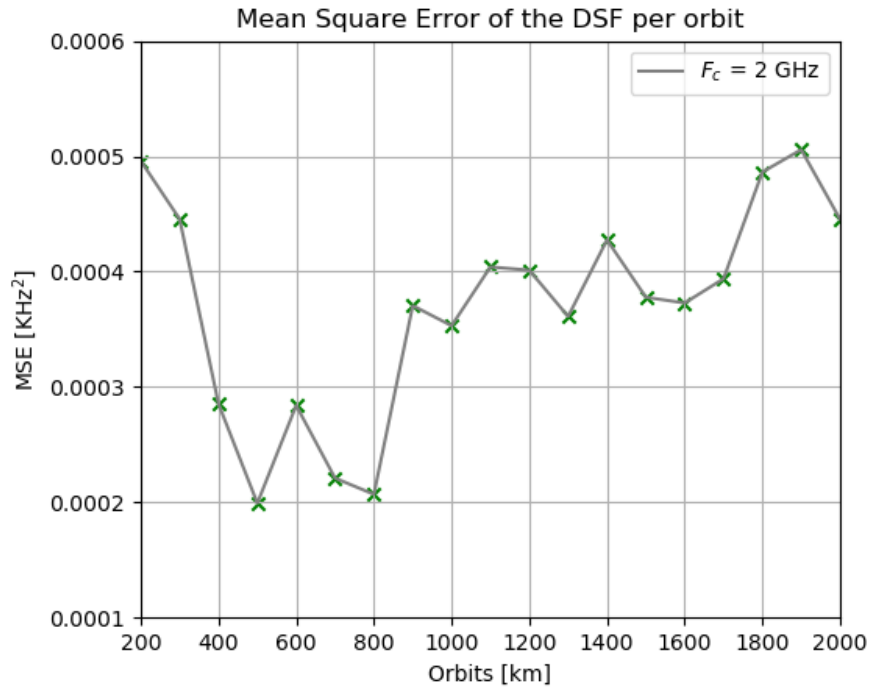- LEO Digital communication systems for which a Doppler channel is required

Deliverables

- VHDL source code or synthesized netlist with testbench

- HDL and Bit-accurate Matlab, C or C++ simulation models

- C++ firmware (Yocto/Petalinux compatible)

- Vivado IP Package

- Comprehensive documentation

Doppler Shift Frequency at f_c = 2 GHz and h = 500 km

Doppler Shift Frequency at f_c = 2 GHz and h = 1500 km

Mean absolute error of the DSF per orbit

Mean percentage error of the DSF per orbit

Mean Square Error of the DSF per orbit

Root Mean Square Error of the DSF per orbit

Related Products

- [Fixed-Point AWGN Channel](#)

About Creonic

Creonic is an ISO 9001:2015 certified provider of ready-for-use IP cores for wired, wireless, fiber, and free-space optical communications. All relevant digital signal processing algorithms are covered, including, but not limited to, forward error correction, modulation, equalization, and demodulation. The company offers the richest product portfolio in this field, covering standards like 3GPP 5G, DVB-S2X, DVB-RCS2, CCSDS, and WiFi. The products are applicable for ASIC and FPGA technologies and comply with the highest requirements with respect to quality and performance. For more information please visit our website at www.creonic.com.

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