Wide Tuning Capability for Spacecraft Transponders

A document presents additional information on the means of implementing a capability for wide tuning of microwave receiver and transmitter frequencies in the development reported in the immediately preceding article, “VCO PLL Frequency Synthesizers for Spacecraft Transponders” (NPO-42909). The reference frequency for a PLL-based frequency synthesizer is derived from a numerically controlled oscillator (NCO) implemented in digital logic, such that almost any reference frequency can be derived from a fixed crystal reference oscillator with microhertz precision. The frequency of the NCO is adjusted to track the received signal, then used to create another NCO frequency used to synthesize the transmitted signal coherent with, and at a specified frequency ratio to, the received signal. The frequencies can be changed, even during operation, through suitable digital programming.

The NCOs and the related tracking loops and coherent turnaround logic are implemented in a field-programmable gate array (FPGA). The interface between the analog microwave receiver and transmitter circuits and the FPGA includes analog-to-digital and digital-to-analog converters, the sampling rates of which are chosen to minimize spurious signals and otherwise optimize performance. Several mixers and filters are used to properly route various signals.

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Analysis of Performance of Stereoscopic-Vision Software

A team of JPL researchers has analyzed stereoscopic vision software and produced a document describing its performance. This software is of the type used in maneuvering exploratory robotic vehicles on Martian terrain. The software in question utilizes correlations between portions of the images recorded by two electronic cameras to compute stereoscopic disparities, which, in conjunction with camera models, are used in computing distances to terrain points to be included in constructing a three-dimensional model of the terrain. The analysis included effects of correlation-window size, a pyramidal image downsampling scheme, vertical misalignment, focus, maximum disparity, stereo baseline, and range ripples. Contributions of sub-pixel interpolation, vertical misalignment, and foreshortening to stereo correlation error were examined theoretically and experimentally. It was found that camera-calibration inaccuracy contributes to both down-range and cross-range error but stereo correlation error affects only the down-range error. Experimental data for quantifying