NASA OSTEM Internship (Summer 2021) Abstract

Category: Space Technology Mission Directorate (STMD), Software Engineering Division

Development of MIPI Camera Interface Prototype Adapter Board
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This project is the development of the prototype FPGA (Field Programmable Gate Array)-Compatible MIPI CSI-2 (Camera Serial Interface) D-PHY adapter board. The FPGA used on the SpaceCube processor card does not have I/O that natively supports the D-PHY standard, and thus requires additional external components to adapt the interface to the FPGAs I/O. The goal of this project is to develop a prototype board with this external circuitry. The project tasks include 1) preliminary research and analysis of the adapter circuit requirements involving waveform comparisons, 2) signal processing chain tests for voltage measurements, 3) calculations from I/O channel system simulations in TI-TINA, 4) components' values and circuit configuration verifications, 5) protoboard schematic entry, 6) both PCB footprint builds and PCB layout in Altium Designer, and lastly, 7) PCB manufacturing. The project requires the applications of fundamental electrical engineering laws such as Ohm's Law and Kirchhoff's Voltage Law for calculations of components' values and signal analysis concepts to build the architecture of the prototype PCB during the iterative development process. The completed PCB shows the 3 receiver networks with confirmed values from the circuit simulations and waveform analyses, the 2 connectors with I/O pin reconfigurations, and both the differential trace pairs and single traces between the components and connectors. The trace routes are subjected to Altium's rules, which enable efficient use of routing parameters for signal integrity. This adapter board is useful in data conversion and transmission from the MIPI camera module to the FPGA, a D-PHY circuit arrangement used in NASA's SpaceCube Mini's VADIR (Versatile Analog/Digital Interface) between the MIPI Camera module and the Backplane Connector. Once the adapter board PCB is fabricated and assembled, it can be used to demonstrate the validity of the circuit design prior to it being incorporated into the VADIR flight board design.