Solder Joint Health Monitoring Testbed

Mike Delaney, James Flynn, Mark Browder

Flight Instrumentation Branch, NASA Dryden Flight Research Center, Edwards CA

Michael.M.Delaney@nasa.gov

Motivation

The primary goal of this research program is to test and validate this method in a flight environment using realistically seen faults in selected FPGA pins, and also to collect temperature, pressure, and humidity data on board the research aircraft. The board will be recorded as an intermittent fault in the electronics, which are similar to BGA and are very common in space flight, and development of prognostics algorithms to calculate the fault localization and time to failure. The SJM system was designed to be easily integrated into research aircraft and to use existing instrumentation infrastructure, such as the Flight Instrumentation Branch (FIB) DATS system.

System Description and Block Diagram

The SJM system is designed to be easy to integrate into standard avionics bays using a compact and lightweight design. The board will have 256MB of SDRAM and 32MB of Flash memory. The onboard memory will allow the use of a MicroBlaze soft-core RISC 422 processor to run prognosis algorithms once they are developed. The SJM system is set up to determine solder joint health on select FPGA pins, and also to collect temperature, pressure, and humidity data on board the research aircraft. The SJM system was designed to use existing instrumentation infrastructure, such as the Flight Instrumentation Branch (FIB) DATS system.

Research Program Overview

A test board is being designed using a Xilinx FPGA. These boards will be tested both in flight and on the ground using a standard 3"X5" layer circuit board designed to fit a standard 3"X5" footprint used at NASA Dryden. The SJM system was designed to be easily integrated into research aircraft and to use existing instrumentation infrastructure, such as the Flight Instrumentation Branch (FIB) DATS system.

Future Work

Future work on this SJM system includes improving the accuracy of the FPGA failure detection algorithm, and further development of the prognostics algorithms to calculate the fault localization and time to failure. The SJM system was designed to be easily integrated into research aircraft and to use existing instrumentation infrastructure, such as the Flight Instrumentation Branch (FIB) DATS system.