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CASES STUDIES ON THE RADIATION HARDENING ASSURANCE TECHNIQUES

Abstract

Avionic electronics exposed to space environment and terrestrial atomsphere suffer from various radiation effects which include total ionizing dose (TID), displacement damage (DD), single event effects (SEE) and electrostatic discharge (ESD). Previous gold radiation testing of simple test chips does not provide the full picture of these effects, especially when restrained by financial budget and time limitation. Radiation hardness assurance testing (RHAT) methods augment the investigation of the contribution of various components to device errors. These methods often employ various abstraction levels modeling and analysis to provide designer the luxury of testing without financial and time constrains, evaluate the radiation hardness and find the vulnerable points. This paper provides a comprehensive survey of spaceborne electronics RHAT techniques, which encompasses how to design, implement, and validate a component of electronics to augment traditional assurance approaches. RHAT techniques can catalog into analytical based, model checking based and devices simulation based approaches. While caused by charge generation induced by ions, the fault might not be seen at different abstraction levels, which depends on how the fault propagates. How various masking mechanisms affecting the analysis are also discussed to decrease the computation payload while meeting required accuracy. This paper ends with cases studies for a comparison with the accelerated ground radiation experiments. Results show that the RHAT accords with traditional methods and RHAT can play a role of guidance of selecting the appropriate soft error mitigation techniques.