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Author: Mr. Ryosuke Fujii
Tokyo University of Science, Japan

Prof. Shinichi Kimura
Tokyo University of Science, Japan

POSSIBILITY OF HARNESS REDUCTION USING COTS PLC TECHNOLOGY

Abstract

In general, harness reduction in autonomous control systems has been attracting much attention. Industrial equipment such as semiconductor manufacturing equipment and industrial robots are interconnected with more than hundreds of harnesses. This holds even for satellites. The number of onboard equipment of satellites has been increasing as mission requirements of satellites including high performance are becoming increasingly complicated. According to increase in the number of onboard equipment, the number of harnesses interconnecting each equipment also increases. Moreover, it is believed that satellites currently contain more than 30000 harnesses that are significant percent of weight of their weight. The number of harnesses significantly influences the cost, weight, system design process, and reliability of satellites. Therefore, harness reduction is a serious issue, especially in small satellites.

Recently, networking technologies such as controller area network (CAN) and SpaceWire have been commonly utilized for small satellites. These networking technologies are gaining attention for not only standardization of communications in spacecrafts but also harness reduction. However, these networking technologies still require a small number of harnesses and cannot be utilized for legacy equipment that cannot communicate with such new interfaces.

In this study, we focused on power line communication (PLC), which is a technology that transmits information signals through power lines that interconnect almost all equipment. Using PLC, it is possible to completely eliminate communication specific harnesses. We developed a small PLC translator unit for satellites by utilizing COTS technologies. The PLC translator unit converts legacy RS422 communication signals into PLC signals and intercommunicates through power lines, thus enabling network connection through power lines. Because it covers legacy RS422 communication on the equipment side, legacy equipment can be easily incorporated in the PLC network. To utilize the PLC translator unit in a space environment, it is necessary to verify its performance under radiation conditions because the unit consists of COTS devices. To this end, we validated its radiation tolerance performance using proton beams generated by a cyclotron. The result indicates that the PLC translator unit has high radiation tolerance.

In this paper, we outline the PLC translator unit for satellites and the possibility of using this unit in a space environment on the basis of radiation test results.