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Planning of the Satellite Automatic Identification System Instrument (SAISI) CubeSat

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An FPGA-based Software-Defined Radio (SDR) was initially a student learning platform for handling communication signals at the physical layer. The automatic identification system (AIS) protocol, a widely utilized maritime communication technology for vessel monitoring and tracking, is followed to validate the transmitting and receiving capabilities. The GMSK modulation with a 9600-kHz symbol rate is realized. The Miniature SDR (MSDR) is, then, developed for cubesat missions in space. With the AIS functionality enabled, the MSDR make the open-sea AIS service possible for vessels in the region that are otherwise out of range from antennas on land, which is critical and valuable in times of emergency. However, with a much wider field of service, multiple signals could potentially arrive at the spaceborne AIS receiver at the same time frame, resulting in signal collision. In this study, we present the MSDR subsystem, specifically designed for cubesats. We also demonstrate implementing successive interference cancellation [1], a previously proposed concept for collision handing, on the MSDR to avoid loss of vessel information. Then, we overview the mission concept, planning, and design of the Satellite Automatic Identification System Instrument (SAISI) cubesat, a 3U cubesat. We highlight the challenges overcome while conceptualizing the mission as a university research group. The SAISI mission is our first step validating the MSDR design for satellite communications. In the future, the MSDR prototype can not only serve as an AIS repeater onboard satellites and vessels to complete the satellite AIS system but also be modified agilely to transmit and receive with a different communication protocol in another frequency band without major updates to the original hardware design.

References

[1] S. Uehashi, Y. Nouda, M. Hangai and T. Ohgane, "Successive Interference Cancellation for Asynchronous Signal Collision in Space-based AIS," *2022 IEEE Aerospace Conference (AERO)*, Aug 2022, doi: 10.1109/AERO53065.2022.9843214.