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Software-Defined Architecture and Front-End Optimization for DO-178B Compliant Distance Measuring Equipment

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Abstract : Among the air navigation technologies, many of them are capable of increasing aviation sustainability as well as accuracy improvement in Alternative Positioning, Navigation, and Timing (APNT), especially avionics Distance Measuring Equipment (DME), Very high-frequency Omni-directional Range (VOR), etc. The integration of these air navigation solutions could make a robust and efficient accuracy in air mobility, air traffic management and autonomous operations. Designing a proper RF front-end, power amplifier and software-defined transponder could pave the way for reaching an optimized avionics navigation solution. In this article, the possibility of reaching an optimum front-end to be used with single low-cost Software-Defined Radio (SDR) has been investigated in order to reach a software-defined DME architecture. Our software-defined approach uses the firmware possibilities to design a real-time software architecture compatible with a Multi Input Multi Output (MIMO) BladeRF to estimate an accurate time delay between a Transmission (Tx) and the reception (Rx) channels using the synchronous scheduled communication. We could design a novel power amplifier for the transmission channel of the DME to pass the minimum transmission power. This article also investigates designing proper pair pulses based on the DO-178B avionics standard. Various guidelines have been tested, and the possibility of passing the certification process for each standard term has been analyzed. Finally, the performance of the DME was tested in the laboratory environment using an IFR6000, which showed that the proposed architecture reached an accuracy of less than 0.23 Nautical mile (Nmi) with 98% probability.

Keywords : avionics, DME, software defined radio, navigation
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