Analyzing Aircraft Surveillance Signal Quality at the 1090 Megahertz Radio Frequency

Junzi Sun*, Jacco M. Hoekstra†
Faculty of Aerospace Engineering,
Delft University of Technology,
Delft, the Netherlands
Email: *j.sun-1@tudelft.nl, †j.m.hoekstra@tudelft.nl

Abstract—Due to the increasing demands for real-time air traffic monitoring, the 1090 megahertz radio frequency has become the most utilized communication channel for aircraft surveillance purposes. Several services are using the radio frequency at the same time, which are Mode A/C communications and Mode S communications. These different types of communications are not coordinated, meaning that the quality of a communication channel can deteriorate with the increasing number of aircraft in the airspace. This deterioration may further worsen with the increasing number of aircraft that comply with the Automatic Dependent Surveillance-Broadcast requirement, which is implemented based on Mode S Extended Squitter.

In this paper, we conduct experiments to determine the quality of 1090 megahertz radio frequency by analyzing the low-level signals using an open-source software-defined radio. First, we implement the demodulation of Mode A/C and Mode S signals from the raw in-phase and quadrature signals with a high sampling rate. Then, several methods are employed to study the occupancy of the communication channel and the garbling severity of the signals, as well as the error rate in ADS-B signals. All results show that the radio frequency is experiencing high communication load during day time air traffic operations. The results also suggest a need for a major redesign of the aircraft surveillance system in the future due to the current inefficient utilization of this radio frequency.