Experimental Results from a Highly Directional Air-to-Ground Communications Link

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When using highly directional antennas in an air-to-ground communications system, accurate antenna boresight calibration is critical. If the antenna boresight is off by even a small amount, it will weaken the received signal power at the receiver, leading to degraded system performance. In our case, the system under test utilized parabolic dish antennas on the ground with a 3 dB beamwidth of only 1.2 degrees to track and maintain connectivity with a moving aircraft. Multiple tests of the system were run over the span of a few months. In this presentation, we will discuss results and findings related to the antenna pointing performance of two of our ground antennas. Due to the system architecture, the antennas were located relatively close together relative to the aircraft, facilitating comparison between the two antennas. Furthermore, the azimuth and received power at both antennas were logged as well as the aircraft position, allowing for comparison between the theoretical performance expected and actual performance observed. As will be discussed in the presentation, one of the antennas consistently performed well over multiple tests, but the other surprisingly exhibited inconsistent behavior which presented challenges that had to be overcome. Some of the troubleshooting methods attempted involved the use of an inertial navigation system to accurately measure the heading and even swapping out the radio and antenna unit with another identical unit in case the issue was due to a defect in the radio and/or antenna. As will be shown, neither of these methods resolved the issue completely, indicating that the issue may have potentially been due to environmental factors at the site that adversely affected the antenna. Ultimately, the received power measurements proved to be the most useful while troubleshooting. The issue was resolved by using the received power measurements to tweak and adjust the antenna heading until consistent received power was observed.

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