ADS-B in-sky safety
– making listen2planes available to download

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The source code for the 'listen2planes' server/client package in operation at the SGF, Herstmonceux is available to download from **GitHub** for SLR stations to implement and develop.

Introduction

An aircraft operating ADS-B technology broadcasts its latitude, longitude and altitude positions and velocities . These messages are intercepted and decoded at the SGF, Herstmonceux for use in in-sky safety during SLR operations. The system has been found to be highly stable, reliable and accurate. This work was reported at the 18th ILRS Workshop in Fujiyoshida, Japan in 2013[1].

The system uses a SBS-3 receiver from Kinetic Avionics to which a server makes a TCP/IP connection and receives the raw binary messages from nearby aircraft. The server (l2pserver.c) decodes these binary messages and makes the results available to multiple client connections via separate TCP/IP connections. The server also provides the telescope pointing direction and the aircraft azimuths and elevations, calculated using the SLR station coordinates (which a must be entered before compilation).
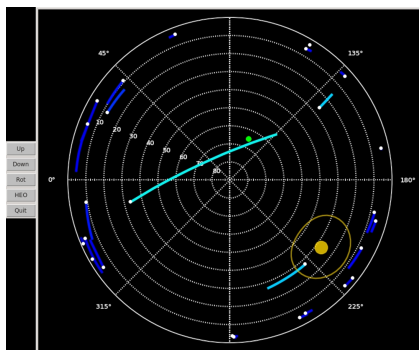

Two clients have been developed, the first is a graphical display of the data coded in Python (l2pgui.py). The second compares the SLR telescope direction and the in-sky aircraft positions (l2pclient.c) and uses the aircraft velocities to predict ahead. A boundary is defined around the moving aircraft which is used to trigger an audible warning of an aircraft approaching the laser beam. The client makes a 10 second and a 2 second prediction, the second of which can be used to inhibit the laser beam.

Download server/client code

The server, clients and example telescope information client are now available on GitHub (*https://github.com/matwiNERC/listen2planes* and *https://github.com/jcrod/l2pGUI*) to be downloaded, implemented, tested and further developed by other SLR stations.

Limitations to ADS-B in-sky safety

ADS-B detection relies on the aircraft carrying the necessary technology and for it to be working correctly. After over a year of observer experience with the listen2planes software package, occasionally aircraft are spotted that are not using ADS-B equipment. In addition, some aircraft messages were detected with erroneous altitude values. Finally, observers have reported aircraft behaviour that suggests a delay between the actual plane position and that reported by the ADS-B messages.

Dual Antenna tests

The gain pattern for a single rod antenna, such as the BS-1105 used at Herstmonceux, is strong towards the horizon in all directions, but weaker with increasing elevation. This results in some ADS-B messages not being detected as aircraft pass overhead. To address this, a second antenna and a 'splitter' were acquired so that two antennas, one positioned vertically and the other horizontally, could be combined. The horizontal antenna will provide higher gain at higher elevations.
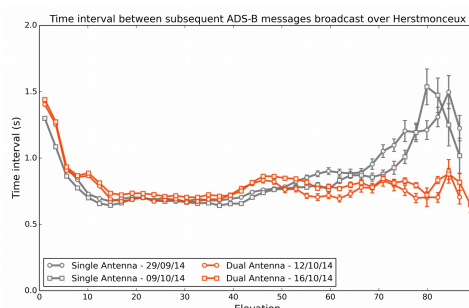
Aircraft message datasets were collected using a single vertical antenna and the dual antenna. The time interval between subsequent messages for individual aircraft were binned, averaged and plotted with standard error against elevation. The plots shows fewer lost messages for the new dual antenna system (red) at higher elevations.

The combination of the two signal cables for the dual system resulted in some overall signal loss, mostly significant below 5 degrees. During these tests the amplifier was found to have failed and was removed. The performance without the amplifier, through 20m of high quality, very low loss cable, was found to still be satisfactory.

References:

[1] Wilkinson M., Rodriguez J. , *Integration of a SBS-3 ADS-B receiver into the SGF, Herstmonceux aircraft safety system*, 18th ILRS Workshop, 2013. (http://cddis.gsfc.nasa.gov/lw18/docs/papers/Session8/13-03-07-Wilkinson.pdf).