

Visitor Research Report

Visitor Name: Dr. Heber Herencia-Zapana
Old Dominion University

Area of Research: Formal Methods

Period of Visit: September 29, 2008 – December 31, 2008

Goal:

In the detection and resolution of air traffic conflicts between two aircraft, the information provided by the GPS is never totally exact, and there are always errors when measuring position and velocity vectors.

Therefore in this visiting it was studied the consequences of these errors and how they influence the actual separation

of an aircraft, and the following conditions are studied. Conditions under which if there is not conflict using the information of the position and velocity provided

by the GPS there is not conflict for the actual position and actual velocity, which are unknown.

Also conditions are presented under which, if a resolution is executed using the information provided by the GPS, this

resolution is also valid for the actual position and actual velocity, which are unknown.

These two conditions are presented as theorems, which were formally proven using PVS.

Strategy:

Conflict detection and resolution algorithms have already been extensively studied and proved.

A two dimensional airspace with two distinguished aircraft is considered: the ownship and the intruder aircraft.

In conflict detection and resolution it is frequently supposed that the position and velocity information provided

by the GPS is perfect, i.e., no measure error is taken into account.

However measure errors are an important issue and this

is why they are studied in this paper. The actual positions and velocities are, of course, unknown, but the position and velocity error are known.

In this visiting it is presented the study of conflict detection and resolution taking in account the measure errors in three steps. First, because the information of the position and velocity is not perfect, the relative position and relative velocity error bounds are obtained. Second, conditions are studied under which if there is not conflict using the information of the position and velocity provided by the GPS there is not conflict for the actual position and actual velocity. Finally, conditions are presented under which, if a resolution is executed using the information provided by the GPS, this resolution is also valid for the actual position and actual velocity. These conditions are presented as theorems and these theorems were formally proven using PVS.

Accomplishments:

This paper presented three main contributions.

First, because the information of the position and velocity is not perfect, the relative position and relative velocity error bounds are obtained. These bounds define the cone of possible future positions for the ownship and intruder.

Second, it was proved using PVS that if D is increased the following is true. If there is not conflict using the information of the position and velocity provided by the GPS, there is not conflict for the actual position and actual velocity. Finally, it was proved in PVS that if the radio D is increased the following is true. If a resolution is executed using the information provided by the GPS this resolution is also valid for the actual position. These three contributions were formally written and verified using PVS.

Future Work:

A future work is to study another ways to decrease the size of these buffers and formally prove using PVS

Pending Publications:

There is one paper that is going to be published

Seminar Presented: A seminar was presented.