# ATH Group Task J CLT AAMS Excess Distance Analysis

As requested by FAA, ATH preformed the Incoming Excess Distance (IXD) analysis by using the ***AwSim***™ tool IXD. The primary function of IXD is to compare a reference file to an object file and obtain the differences between the two files. In this operational evaluation, the object file used was the 'realized' (or as-flown) trajectory, and the reference file used was the flight-plan (or planned trajectory).

The results were that:

- AAMS Exchange operations produced a benefit outside of the corner post, and,
- ATH's "day of" metrics as measured by ATH Attila™ Statistical Tool compare very closely to the results of ERAU's Dwell Time savings results when Excess Distance is added to the results.

## 1.1. Background

For this analysis, an "area of analysis" surrounding each arrival fix of the airport was created. This area was a circle of 100NM radius around each arrival fix (figure 1).

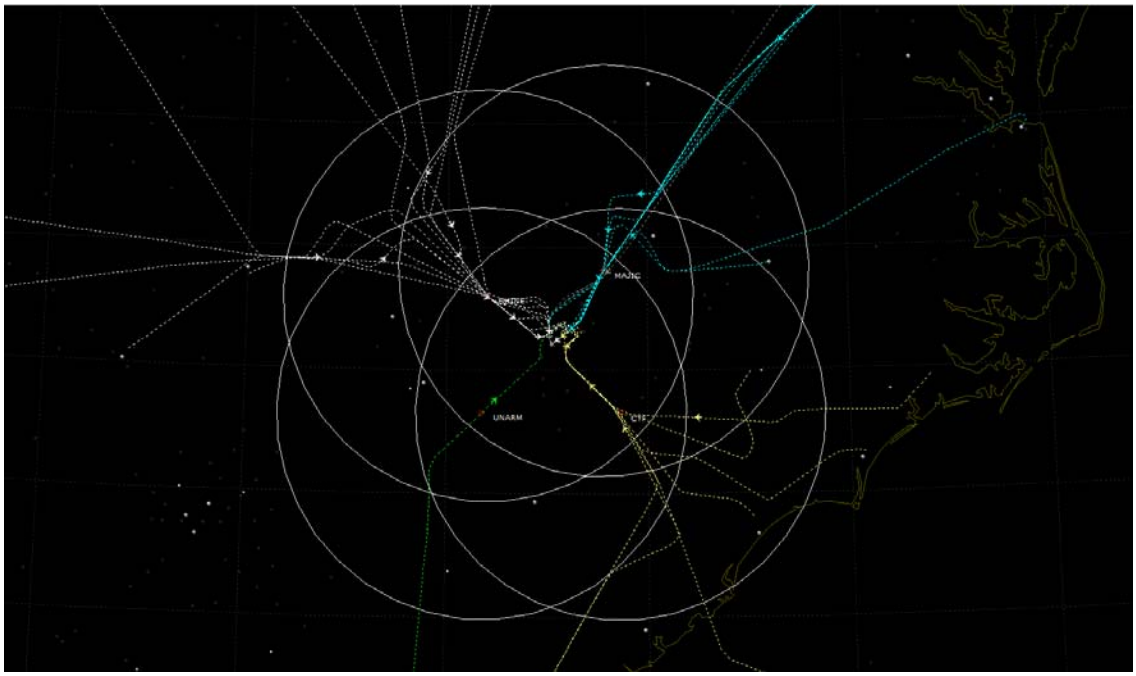


**Figure 1. 100nm circle around each corner post**

ATH then calculated the different metrics of interest from the moment a flight crossed into this circle to the moment that the same flight crossed (abeam) the arrival fix point. Three metrics were generated that describe the difference between the reference trajectory and the object trajectory in terms of deviation from flight plan, excess distance, and excess time.

These metrics are:

- ***dMaxLatDev*** - This describes the lateral deviation between the "as flown" trajectory and the flight plan trajectory expressed as nautical miles. (figure 2). This is a good measure of the amount of deviation, and it has the advantage of being less affected by such events as holding.
- ***dDur*** - dDur is the measure of the difference in duration within the area (excess time), measured in minutes. This metric is defined as the difference in the flight-duration, in minutes, between the planned and flown trajectories.
- ***dExcDist*** – dExcDist is the difference between the Track Length (which is the actual path the flight took) and the direct distance (straight-line distance connecting two points). **dExcDist** is the difference in excess distance between the planned and flown trajectories.

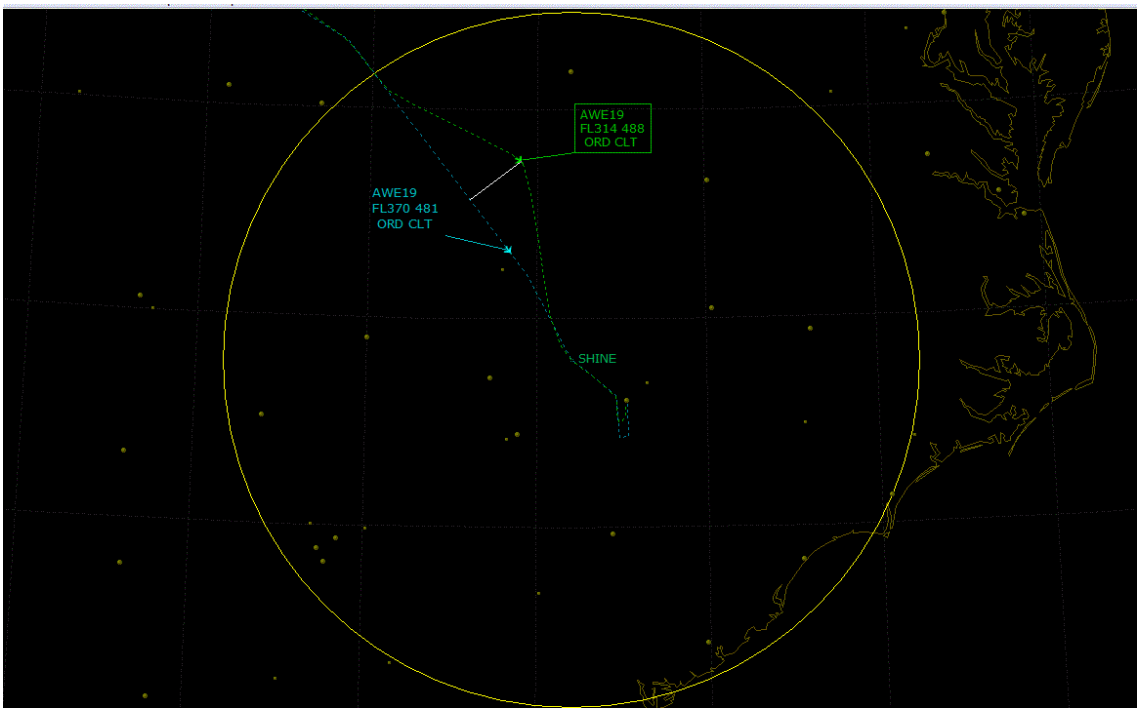


**Figure 2. Maximum Lateral Deviation of a flight en route to the airport.**

## 1.2. Data

ATH used three sets of data for this analysis. These were: AAMS Passive, AAMS Active, and AAMS Exchange.

### 3.1.1. AAMS Passive Operation

The passive data set comprises data taken between 9/16/2010 to 12/12/2010 in CLT.

During this period, the AAMS optimization system was running and generating RTAs. These RTAs were collected, but were not sent to the aircraft.

### 3.1.2. AAMS Active Operation (Single Airline)

The active data set comprises data taken between 12/13/2010 and 6/12/2011in CLT.

During this period, the AAMS optimization system was running and generating RTAs. These RTAs were actively transmitted to the aircraft, and results were measured.

### 3.1.3. AAMS Exchange Operation

The active data set comprises data taken between 6/14/2011 and 12/13/2011 in CLT.

During this period, the AAMS optimization system was running independently at two airlines, and generating RTAs. These RTAs were then sent to the AAMS Exchange function for approval and then back to the airline where they were transmitted to the aircraft.

## 1.3. Filters

The data was filtered for trajectories had much greater (or much less) excess distance than could reasonably be attributed to AAMS optimization. This occurred, for example, when ATH observed a small dMaxLatDev (indicated very little lateral deviation) and very large excess distance. This condition exists for the most part due to holding near the corner post.

ATH see that holding events typically result in a small lateral deviation and a large excess distance. To remove these cases, ATH filtered data with an excess distance greater than 30 nm (Figure 3).

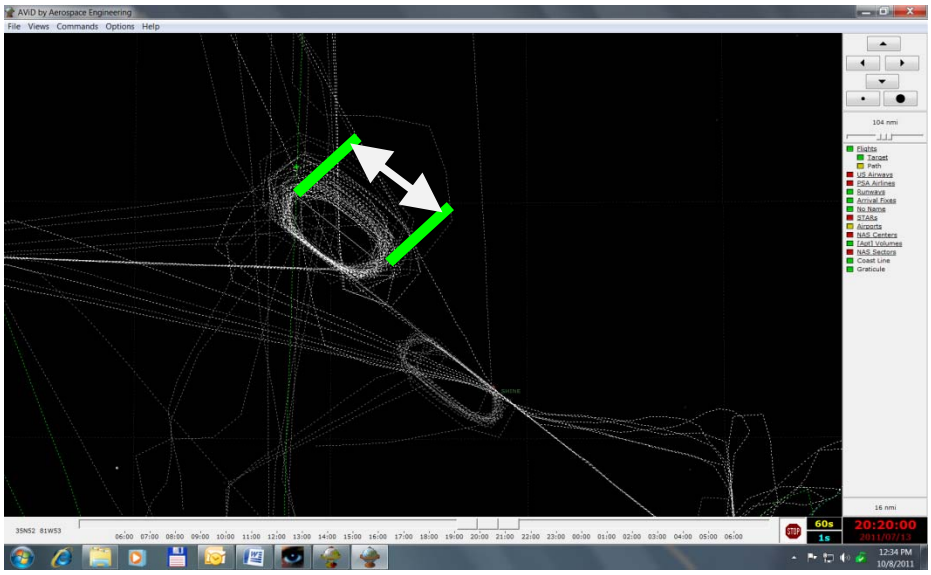

**Figure 3. Holding**

## 1.4. Results

Table1 below summarizes the results for each of these periods.

## Table 1. Excess Distance

| Period | US Airways Flights | | | | PSA Flights | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean dDur (min) | Mean dExcDist (NM) | Mean dMaxLatDev (NM) | Number of Flights | Mean dDur (min) | Mean dExcDist (NM) | Mean dMaxLatDev (NM) | Number of Flights |
| **Attila™ Passive Ops** | 0.39 | 0.30 | -0.70 | 17,463 | -1.43 | 0.00 | -1.36 | 8,294 |
| **Attila™ Single User Active Ops** | 0.21 | 0.00 | -1.07 | 32,968 | -2.14 | -0.60 | -1.95 | 16,822 |
| **Attila Exchange™ Ops** | 0.04 | -0.10 | -1.02 | 11,135 | -1.88 | -0.60 | -2.04 | 5,538 |
| **Attila Exchange™ Runway Closed Ops** | 0.28 | 0.10 | -0.94 | 12,607 | -1.77 | 0.10 | -1.18 | 6,006 |
| **Attila Exchange™ Post Runway Closed Ops** | 0.23 | -0.20 | -1.27 | 18,756 | -1.9 | -0.70 | -2.11 | 8,620 |
| **Benefit between Passive Attila™ and Attila Exchange™ Active Ops** | **0.25** | **0.40** | 0.57 | | **0.47** | **0.70** | 0.75 | |

**Table 2. Excess Distance**

| Period | All other flights | | | |
|---|---|---|---|---|
| | Mean dDur (min) | Mean dExcDist (NM) | Mean dMaxLatDev (NM) | Number of Flights |
| **Attila™ Passive Ops** | -0.07 | -0.30 | -1.72 | 19,220 |
| **Attila™ Single User Active Ops** | -0.26 | -0.60 | -2.05 | 39,239 |
| **Attila Exchange™ Ops** | -0.24 | -0.40 | -1.78 | 13,675 |
| **Attila Exchange™ Runway Closed Ops** | -0.14 | -0.30 | -1.67 | 14,145 |
| **Attila Exchange™ Post Runway Closed Ops** | -0.32 | -0.70 | -2.11 | 20,230 |
| **Benefit between Passive Attila™ and Attila Exchange™ Active Ops** | 0.29 | 0.35 | 0.36 | |

If one assumes that Passive AAMS Ops is the baseline, then one should expect to see all of these metrics decrease during AAMS Single User Active and AAMS Exchange phases (i.e., all numbers are lower during Active Attila™ operations). This indicates that less time and/or distance had been flown within the defined area, and that AAMS was generating benefit.

Note that there is a clear reduction in both flight time and flight distance in the AAMS Single User Active and AAMS Active Exchange phases versus the AAMS Passive time period.

## 1.5. Multi-User Attila™ Metrics Comparison to ERAU AAMS Active Exchange and Excessive Distance Analysis

As seen in Addendum 1, the ERAU analysis of the AAMS Active Exchange phase showed a reduction of time inside the corner post (Dwell time) of 31.81 seconds.

Therefore, if the 31.81 second per compliant flight is used as a benchmark, it can be then compared to the number of flights in the AAMS Exchange phase.

Optimized US/PSA flights * compliance * Compliant reduced Dell Time = Time Saved/day

171 flights/day * 37.2% * (31.81/60) = Time Saved (Dwell) per day = **34 min/day (Dwell)**

However, to get the complete picture, the 15.94 minutes of Dwell Time Saved for the non-compliant fights must also be included.

Non-Optimized US/PSA flights * Non-Compliant reduced Dwell Time = Time Saved/day

(181) flights/day * (15.94/60) = Time Saved (Dwell) per day = **48 min/day (Dwell)**

Now, adding the reduced dwell time inside the corner post for all US Airways and PSA flights, as extrapolated from the ERAU results, it shows:

34 min/day (Dwell) + 48 min/day (Dwell) = **Total of 82 min/day (Dwell)**

Next, one must add the reduced time for the distance saved (dDur) outside of, but within 100 NM of the corner post.

Total US/PSA flights/day * dDUR per/ flight = Time Saved/Day (Excess Distance)

(352) US/PSA flights/day * (.25) = Time Saved (Dwell) per day = **88 min/day (Ex Dist)**

Adding the reduced dwell time inside the corner post plus the reduced Excess Distance outside of, but within 100 NM of the corner post for just US Airways and PSA flights, it shows:

82 min/day (Dwell) + 88 min/day (Ex Dist) = **Total of 170 min/day (Dwell + Ex Dist)**

ATH's "day of" average Flight Time Saved as measured by ATH's AST software for USAir/PSA flights is 205 minutes, which compares very closely to the calculated Flight Time Saved using ERAUs Dwell Time Savings results, plus excess distance saved, again, just for USAir/PSA flights of 170 min/day.

These numbers become even closer if the AAMS benefit produced when AASM and TMA are both operational is included, which is not the case for this comparison.

## 1.6. Summary

AAMS delivered a strong and consistent daily benefit during the entire AAMS period.

In addition, it is clear that, as ERAU has concluded, an increased number of aircraft will increase these benefits. For example, benefits would be increased by including additional airlines, US Airways Tactical Cost Index (TCI) flights and additional regional carriers.