

EDITORIAL

## Reviews and Responses for A Catalogue of Deconfliction Actions Extracted from Historical ADS-B Data

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**Reviewers:** Vishwanath Bulusu and Raúl Sáez

**Editor:** Martin Strohmeier

### 1. Original paper

DOI for the original paper: <https://doi.org/10.59490/joas.2023.7222>

### 2. Review - round 1

#### 2.1 Reviewer 1

Very well-written paper for the symposium proceedings. It was easy to read and understand how the authors intended and created a catalog of deconfliction maneuvers accounting for ATC's human factors in resolution decision-making based on ADS-B data. ADS-B data is the new mecca for air traffic research and uses like this can inform further diversification of tools that can be used for more advanced ATM research for novel entrants.

A few things to note:

1. The paper says that traditional methods fail to account for cognitive processes and human factors. There is a rich body of literature that accounts for human factors in conflict resolution. For example, see work by Dirk Schaeffer, and NASA's FACET and NAS-Digital Twin implementations
2. In 4.4. I was curious what the *min<sub>r</sub>, eal<sub>s</sub>ep* was excluding the erroneous 3.929 NM one.
3. Longer separations may not necessarily mean non-deconfliction maneuvers. They could be just strategic deconfliction that can keep aircraft 20 plus NM separated. A better way to put it could be that you are focused on only tactical resolutions and not strategic resolutions(which are over longer time and distance horizons).

#### 2.2 Reviewer 2

In this paper, the authors propose a methodology to detect deconflicted situations from ADS-B data, in which ATC solve the conflict by issuing heading instructions, thus, changing the lateral path followed by the aircraft.

The paper is well-written and easy to follow. Furthermore, the authors clearly identify the current limitations of their approach and possible ways to improve it in the future, which I really appreciate.

Still, I have some comments:

- a) There is one thing that remains unclear to me concerning the methodology. In Section 3.2, the authors explain what is considered to be a trajectory that deviates laterally from its flight plan. It seems the authors consider the set of navaids found in the flight plan and check if the trajectory is aligned with them or not. Are all navaids considered in this case at the same time? Are the authors dividing the trajectory into several parts and checking this alignment? Or is the "area of interest" small enough so that it is not necessary to do this discretization? Actually, this "area of interest" size is linked with what is explained in Section 3.1. The authors mention the ACC of Bordeaux, so I understand the authors just consider the part of the flight trajectories which is managed by this ACC, right? I would appreciate having more details clarifying this topic, and maybe giving more details regarding the scenario (i.e., ACC Bordeaux).
- b) The authors wrote in line 178 the following: "we use a prediction following the flight plan". I would like to know more details regarding this trajectory prediction algorithm the authors use. Is all required data for the prediction (e.g., speeds, altitudes, lateral route...) extracted from the flight plan? Are the authors considering some additional elements?
- c) Throughout the paper and in Section 6, the authors mention several ways to improve the current methodology to make the conflict detection more reliable. Have the authors considered to use some of the existing approaches in the current literature or some of the approaches some of the authors of this paper used in prior research?
- d) Currently, the validation of the results of this work is quite limited, relying on a "visual check" of a fraction of the flights considered in this paper. Have the authors considered comparing their results with other similar studies to further extend the "scope" of this validation? Or, even better, would it be possible to compare the results with real statistics regarding traffic deconfliction (i.e., actual number of ATC heading instructions and aircraft involved for a given ACC)? Regarding this, I do not know how easy would it be to obtain this kind of data, but it might be interesting to do such a kind of comparison. I would appreciate the authors adding some discussion regarding this topic in Section 6.
- e) In Figure 3, in the horizontal axis, the "40.0" is on top of the "36.0". I recommend the authors to move slightly these numbers or, even better, remove the ".0" from all the numbers in the x-axis (unless the authors have a specific reason to keep them as "floats").
- f) Line 253: please, add a comma after "In other words"; Line 254: add a "-" between red and dashed: red-dashed

### 3. Response - round 1

We would like to kindly thank you for your comments, we appreciate the constructive feedback to our research and are grateful for any improvement suggestions. In what follows, we are responding to each of the comments separately.

#### 3.1 Response to reviewer 1

1. The paper says that traditional methods fail to account for cognitive processes and human factors. There is a rich body of literature that accounts for human factors in conflict resolution. For example, see work by Dirk Schaeffer, and NASA's FACET and NAS-Digital Twin implementations

#### Response

We thank you for the citation keys. We will keep the references at hand for when our future research goes towards human factors.

2. In 4.4. I was curious what the *min\_real\_sep* was excluding the erroneous 3.929 NM one.

#### Response

Indeed, we had failed to include that information. It is now included in the manuscript before Section 5.

3. Longer separations may not necessarily mean non-deconfliction maneuvers. They could be just strategic deconfliction that can keep aircraft 20 plus NM separated. A better way to put it could be that you are focused on only tactical resolutions and not strategic resolutions (which are over longer time and distance horizons).

#### Response

This detail has been added to section 1.

### 3.2 Response to review 1er 2

a) There is one thing that remains unclear to me concerning the methodology. In Section 3.2, the authors explain what is considered to be a trajectory that deviates laterally from its flight plan. It seems the authors consider the set of nav aids found in the flight plan and check if the trajectory is aligned with them or not. Are all nav aids considered in this case at the same time? Are the authors dividing the trajectory in several parts and checking this alignment? Or is the "area of interest" small enough so that it is not necessary to do this discretization? Actually, this "area of interest" size is linked with what is explained in Section 3.1. The authors mention the ACC of Bordeaux, so I understand the authors just consider the part of the flight trajectories which are managed by this ACC, right? I would appreciate having more details clarifying this topic, and maybe giving more details regarding the scenario (i.e., ACC Bordeaux).

#### Response

We do indeed only consider the part of the flight trajectories managed by the ACC of Bordeaux. When checking for alignment, we consider all nav aids that are included in the flight plan at a distance of 200 NM or less from the aircraft at a given time. This detail was added to section, 3.2.

b) The authors wrote in line 178 the following: "we use a prediction following the flight plan". I would like to know more details regarding this trajectory prediction algorithm the authors use. Is all required data for the prediction (e.g., speeds, altitudes, lateral route...) extracted from the flight plan? Are the authors considering some additional elements?

#### Response

The prediction is based on a constant altitude, specifically the aircraft's altitude just before deviating. Speed is an unchanging average derived from the 20 minutes leading up to the deviation. The prediction assumes instantaneous turns and does not consider physical constraints during this process. This information was added in section 3.4.

c) Throughout the paper and in Section 6, the authors mention several ways to improve the current methodology to make the conflict detection more reliable. Have the authors considered to use some of the existing approaches in the current literature or some of the approaches some of the authors of this paper used in prior research?

Response

This paper focuses on the implementation of a simple heuristic method. In the future, we do plan to add to this development, possibly using existing research. These improvements will be addressed in our next papers.

d) Currently, the validation of the results of this work is quite limited, relying on a "visual check" of a fraction of the flights considered in this paper. Have the authors considered comparing their results with other similar studies to further extend the "scope" of this validation? Or, even better, would it be possible to compare the results with real statistics regarding traffic deconfliction (i.e., actual number of ATC heading instructions and aircraft involved for a given ACC)? Regarding this, I do not know how easy would it be to obtain this kind of data, but it might be interesting to do such a kind of comparison. I would appreciate the authors adding some discussion regarding this topic in Section 6.

Response

We plan to further validate our results using a recent dataset in which controller actions are labelled. Though it does not directly concern deconfliction, comparing our data with these labels would constitute a partial verification of our heuristic. This new reference was added to section 6. We will research and implement additional validation steps in future research.

e) In Figure 3, in the horizontal axis, the "40.0" is on top of the "36.0". I recommend the authors to move slightly these numbers or, even better, remove the ".0" from all the numbers in the x-axis (unless the authors have a specific reason to keep them as "floats").

Response

Figure 3 was updated and numbers were changed to integers.

f) Line 253: please, add a comma after "In other words"; Line 254: add a "-" between red and dashed: red-dashed

Response

These modifications were added to section 4.3.