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Aircraft noise: Conversion of an existing to a desired number of subtracks with identical lateral dispersion to obtain smooth noise contours

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EXTENDED ABSTRACT

Introduction

In aircraft noise calculations, the dispersion of flight tracks on a certain air route is often represented by a backbone track and a number of laterally displaced subtracks, where each track is assigned a fraction of the route's movements to obtain a certain lateral distribution [1]. For routes with a large dispersion of the flight tracks, the number of subtracks should be larger than for routes with small dispersion to obtain smooth footprints (i.e., single event level grids or contours) in both cases. However, if subtracks are drawn by hand using expert knowledge, e.g. because no reference radar data is available, the number of available tracks is usually limited. Here, it can be useful to be flexible in the creation of additional and/or modification (smoothing) of existing subtracks.

Methods

In this contribution, we present a method to construct a different (usually larger) number of subtracks based on a set of existing subtracks by geometric matching of the subtracks with the backbone track. The method consists of two steps: first, the existing subtracts are matched with the backbone track, i.e. each point on either track is assigned to a matching point on the other tracks using a similarity measure, and second, a different number of subtracks is constructed. The latter assumes identical lateral dispersion of the converted tracks to the original subtracks. For the matching, it is important to choose a method that is robust with respect to the sampling and to the nature of the tracks (e.g. very tight turns, edges in the curves, ...). In this case, the matching is done using a two-dimensional implementation of the dynamic time warping algorithm (2D-DTW). The matching points on the tracks can then be used to estimate the local lateral distribution function, which serves as a basis for calculating the geometric location of the new subtracks.

Results

We show example cases of aircraft noise calculations featuring tracks with tight turns and non-symmetric subtracks with respect to the backbone track, and compare resulting footprints with those computed based on the original tracks. The aircraft noise calculations are done using FLULA2 004 [2], and differences in receiver grid levels are shown. Results indicate that, depending on the nature of the tracks, a different number of subtracks is appropriate. For flight routes with low lateral flight dispersion, increasing the number of subtracks has a negligible impact on noise contours, while widely dispersed tracks require a larger number of subtracks.

Conclusion

The presented method allows the up-sampling of the number of subtracks for a flight route. It is based on a matching algorithm between the original tracks, followed by the construction of the new subtracks using an estimate of the local movement distribution. Results indicate that the geometry of the original tracks dictates whether the number of available tracks is sufficient, and whether an increase in the number of tracks is advisable.

Keywords: Aircraft Noise, Ground Tracks, Flight Trajectories, Lateral Flight Dispersion

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