CALCULATION OF NOISE CONTOURS AROUND AIRPORTS

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Abstract: *This article refers to the process of generating the noise contour around airports and how noise levels can be mediated or accumulated to generate noise index values. Regardless of the source of the flight data, each aircraft movement is defined taking into account the flight path geometry and the noise emitted by the aircraft following its flight path. The contour calculation methodology recommended by European Standards involves segmenting the flight path to suit each other independently.*

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1. INTRODUCTION

Worldwide, the overall noise level is alarmingly high. we live in a noisy society mainly due to the technological environment in which we evolved.

In order to have relevant information about the magnitude and magnitude of the impact caused by aircraft noise around airports, maps that have marked outline contours are required. A noise contour is generated by the mathematical calculation of the areas where there are noise indices and is marked by a line along which the index value is constant. The way noise is perceived at airport ground points depends on several factors, such as: type of aircraft, types of engines used by aircraft, procedures applied by them to adjust engine power, flaps and speed to air.

Through this paper I want to deal in detail with the modeling and generation of the noise contour and focus on the way of calculating the noise levels produced by individual aircraft events and how the noise levels can be mediated or accumulated to generate values of the zig-zag index at a certain point.

2. CALCULATION OF NOISE CONTOURS

Two kinds of noise contours can be matheatically calculated, depending on the need the observer:

- Contours used to generate the historical noise impact They are the result of current records of aircraft operations - movements, operational weights, flight trajectories measured on radar, etc.
- Contours used to make forecasts based on estimates of airport traffic, flight paths, and aircraft characteristics that will use the airport.

When noise contours are obtained by interpolation between index values at rectangularly spaced grid points, their accuracy depends on the choice of the grid spacing ΔG, especialy within celles where large gradients in the spatial distribution of the index cause tight curvature of the contours, (see fig. 1).

Interpolation errors are reduced by narrowing the grid spacing, but as this increases the number of grid points, the computation time is increased. Optimising a regular grid mesh involves balancing modelling accuracy and run time.

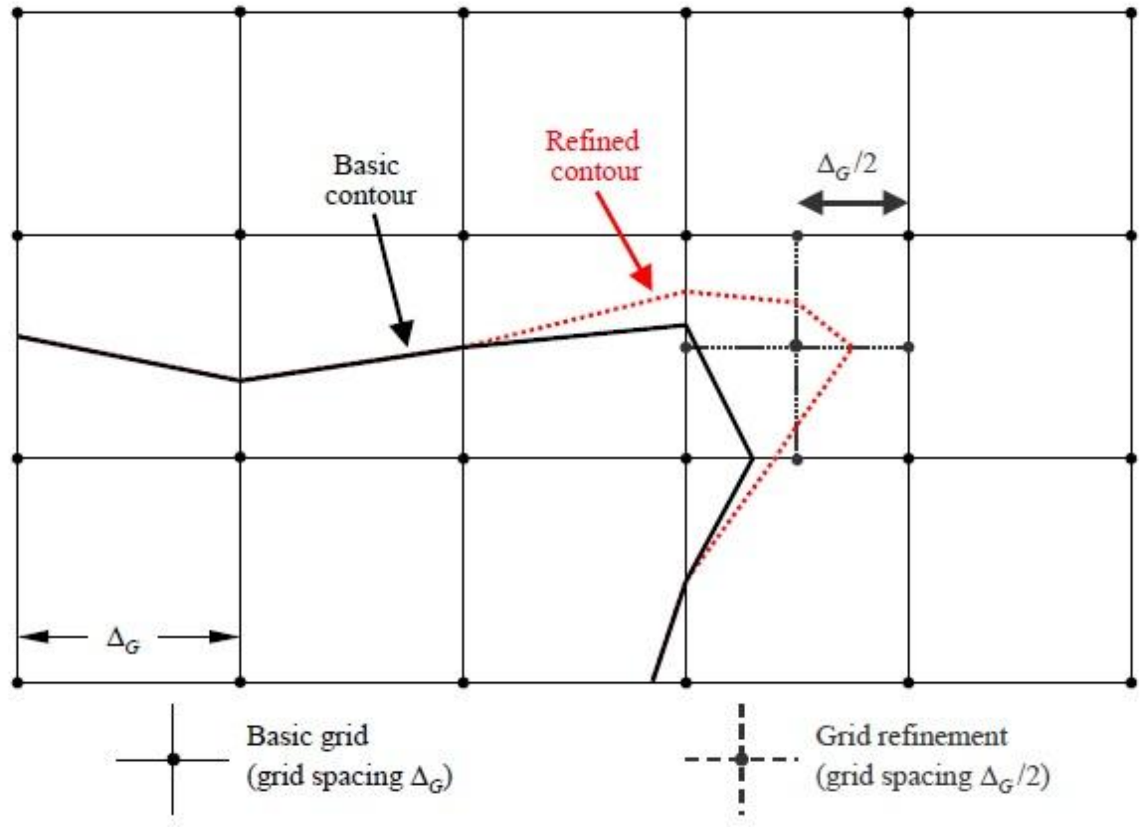

FIG. 1. Standard grid and grid refinement

A marked improvement in computing efficiency that delivers more accurate results is to use an irregular grid to refine the interpolation in critical cells. The technique, depicted in Figure 1, is to tighten the mesh locally, leaving the bulk of the grid unchanged. This is very straightforward and achieved by the following steps:

1. Define a refinement threshold difference ΔL_R for the noise index.
2. Calculate the basic grid for a spacing Δ_G.
3. Check the differences Δ_L of the index values between adiacent grid noise.
4. If there are any differences $\Delta_L > \Delta L_R$ define a new grig a spacing $\Delta_G/2$ and estimate the levels for the new nodes in the fallowing way:

IF $\Delta L \leq \Delta LR$ calculate the new value by linear interpolation from the adjacent ones.
$\Delta L > \Delta LR$ calculate the new value completely anew from the basic input data.

5. Repeat steps 1–4 until all differences are less than the threshold difference.
6. Estimate the contours by linear interpolation.

If the array of index values is to be aggregated with others (e.g. when calculating weighted indices by summing separate day, evening and night contours) care is required to ensure that the separate grids are identical.

2.1. Use of rotated grids

In many practical cases, the true shape of a noise contour tends to be symmetrical about a ground track. however if the direction of this track is not aligned with the calculation grid, this can cause result in an asymmetric contour shape.

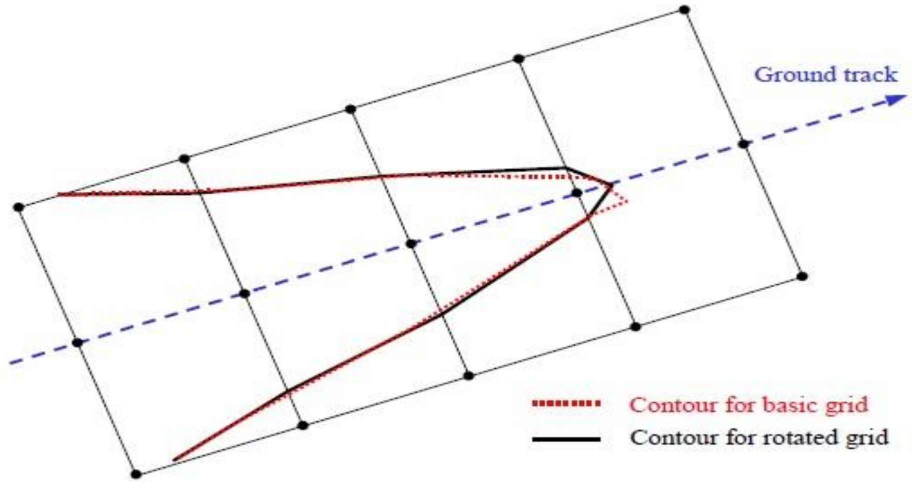

FIG. 2. Use of a rotated grid

The straightforward way to avoid this effect is to tighten the grid. However this increases computation time. A more elegant solution is to rotate the computation grid so that its direction is parallel to the main ground tracks (eg. usually parallel to the main runway). Figure 2 shows the effect of such a grid rotation on the contour shape.

2.2 Tracing of contours

A very time-efficient algorithm that eliminates the need to calculate a complete grid array of index values at the expense of a little more computational complexity is to trace the path of the contour, point by point. This option requires two basic steps to be performed and repeated (see Fig. 3):

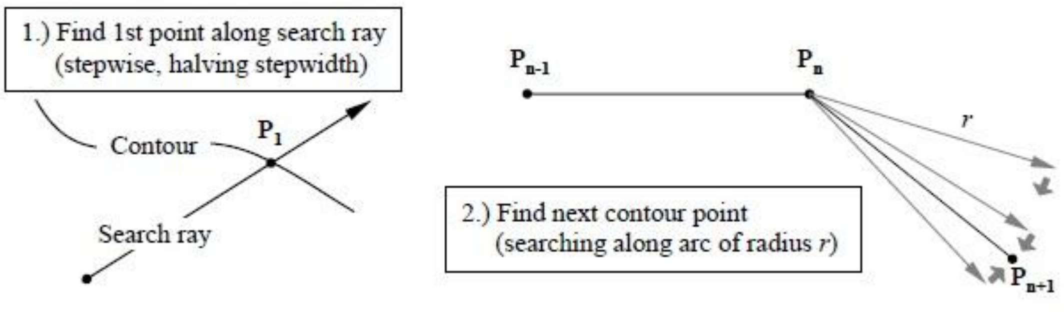

FIG. 3

• step 1 is to find a first point p_1 on the contour. this is done by calculating the noise index levels *l* in equidistant steps along a 'search ray' that is expected to cross the required contour of level l_c. when the contour is crossed, the difference $\delta = l_c - l$ changes sign. if this happens, the step-width along the ray is halved and the search direction is reversed. this is done until δ is smaller than a pre-defined accuracy threshold.

• step 2, which is repeated until the contour is sufficiently well defined, is to find the next point on the contour L_C - which is at a specified straight line distance *r* from the current point. During consecutive angular steps, index levels and differences δ are calculated at the ends of vectors describing an arc with radius *r*. By similarly halving and reversing the increments, this time in the directions of the vector, the next contour point is determined within a predefined accuracy.

CONCLUSIONS

The future development of air traffic involves a complex control of the noise generated by it. Diminishing exposure of the population to noise is one of the main activities required.

Noise modeling is the means by which acoustic mapping is performed in the vicinity of the airport, quantifying the exposure of the population to different levels of noise.

Also, by modeling, reduction scenarios such as changing the overhangs in the sense of distancing these colors to sensitive areas, simulating the removal of major aircraft categories.

A knowledge of population exposure influences a series of decisions on exposure reduction, such as: redistribution of air traffic at different intervals of the day, regulations on the composition of air traffic.

Airborne noise monitoring provides a database that updates in real time, helping to obtain more accurate data and a wider range of factors that impact on noise.

REFERENCES

[1]. ECAC.CEAC DOC.29, 3rd edition, Vol. 1: Methodology for Computing Noise Contours around Civil Airports, Applications Guide. European Civil Aviation Conference, 2005.(www.ecac-ceac.org);

[2]. Acoustics -- Description, measurement and assessment of environmental noise -- Part 2: Determination of environmental noise levels, ISO 1996-1;

[3]. ICAO, Annex 16 -Environmental Protection, Volume I - Aircraft Noise, 5th Edition, Canada, 2008. (www.icao.int).