

# Supplement for "Analyzing the effect of equal-angle spatial discretization for sound event localization and detection"

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## 1 Mathematics of equal-angle spatial discretization

### 1.1 background

A 3D sphere can be discretized along its axes of inclination  $\theta = [0, \pi] \in \mathbb{R}$  and azimuth  $\phi = [0, 2\pi) \in \mathbb{R}$ . The discretization is done using a train of Dirac deltas on the sampling function:

$$s(\theta, \phi) = \sum_{i=0}^{N_I-1} \sum_{j=0}^{N_A-1} \alpha(\theta) \delta(\cos(\theta) - \cos(\theta_i)) \delta(\phi - \phi_j). \quad (1)$$

Where  $\alpha(\theta)$  is a coefficient that is strictly increasing in  $\theta \in [0, \frac{\pi}{2}]$  [Theorem 3.11 Rafaely, 2015].  $N_I$  is the number of points sampled along the inclination axis and  $N_A$  is the number points along the azimuth axis. The points are:

$$\theta_i = i \frac{\pi}{N_I}, i = 0, 1, 2, \dots, N_I - 1 \quad (2)$$

$$\phi_j = j \frac{2\pi}{N_A}, j = 0, 1, 2, \dots, N_A - 1. \quad (3)$$

## 1.2 proof that equal-angle spatial discretization is irregularly spaced as a function of inclination

For any  $\theta_i \in [0, \frac{\pi}{2}]$ , let two neighboring points  $x, y$  on the azimuth axis sampled using (1), *i.e.*,  $x = (\theta_i, \phi_j)$ ,  $y = (\theta_i, \phi_{j+1})$ . Then, the euclidean distance between neighboring points  $x, y$  is strictly decreasing in  $\theta_i$ .

*Proof*

fixate  $\bar{\theta} \in (0, \frac{\pi}{2})$

$$||s(\bar{\theta}_i, \phi_j) - s(\bar{\theta}_i, \phi_{j+1})|| = \bar{c} \quad (4)$$

now let  $\tilde{\theta} < \bar{\theta}$

$$||s(\tilde{\theta}_i, \phi_j) - s(\tilde{\theta}_i, \phi_{j+1})|| = \tilde{c} < \bar{c} \quad \square \quad (5)$$

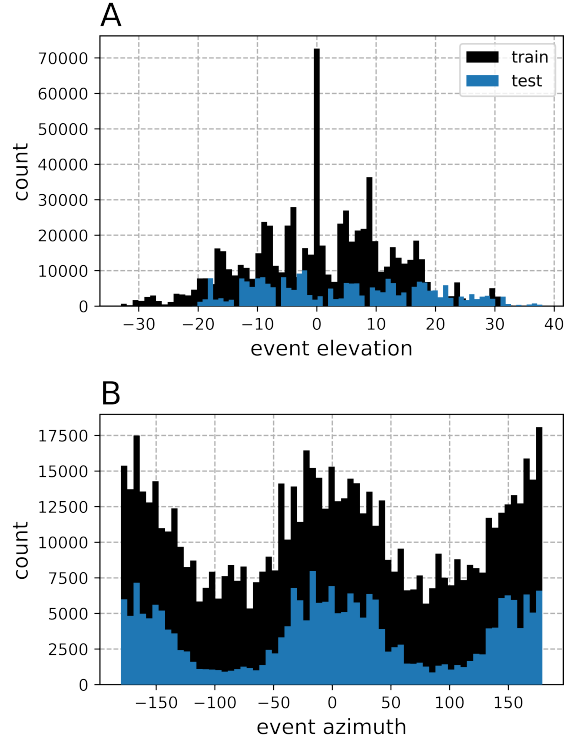


Figure 1: Density of sound events locations in the STARS2022 (+ supplemental synthetic) dataset along the elevation (A) and azimuth axes (B). Data is highly non-uniform along the elevation axis.

## 2 Data distribution for baseline data