# 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:

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

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:

$$\theta_i = i\frac{\pi}{N_I}, i = 0, 1, 2, ..., N_I - 1 \tag{2}$$

$$\phi_j = j\frac{2\pi}{N_A}, j = 0, 1, 2, ..., N_A - 1. \tag{3}$$

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

For any $\theta_i \in \left[0, \frac{\pi}{2}\right]$, 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 $\bar{\theta} \in (0, \frac{\pi}{2})$

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

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

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

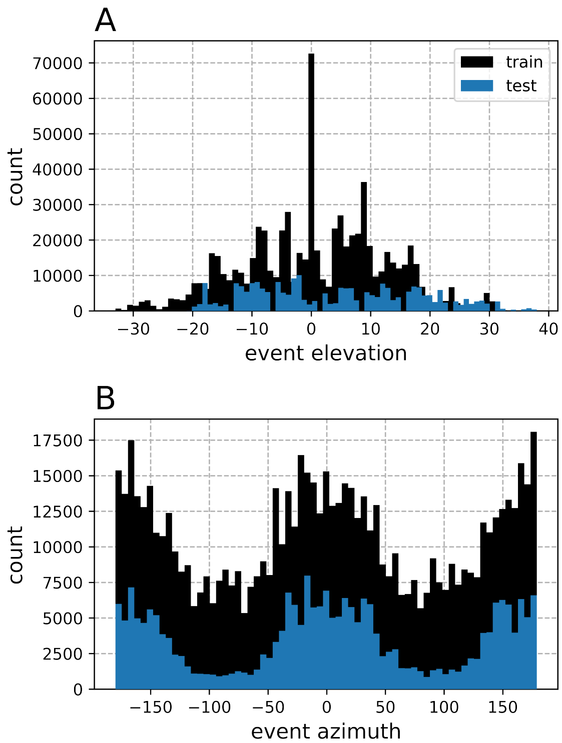


Figure 1: Density of sound events locations in the STARS2022 (+ supplemental synthetic) dataset along the elevation (A) and azimuth axes (B). Data is highly non-uniform along the elevation axis.

# 2 Data distribution for baseline data