Co-integration of acoustic simulation software and GIS for speech intelligibility analysis in complex multi-source acoustic environments. Application to Toledo's Cathedral

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Speech intelligibility in multi-speaker environments

**Assessment criteria**

- Privacy distance, \( r_p \): distance from speaker where the speech transmission index falls below 0.20.
- Distraction distance, \( r_D \): distance from speaker where the speech transmission index falls below 0.50.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Distance from target speaker</th>
<th>Distance from interf. speaker</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal</td>
<td>( d_{ts} &lt; r_D )</td>
<td>( d_{ts} &gt; r_p )</td>
</tr>
<tr>
<td>Acceptable</td>
<td>( d_{ts} &lt; r_p )</td>
<td>( d_{ts} &gt; r_p )</td>
</tr>
<tr>
<td>Unacceptable</td>
<td>Any distance</td>
<td>( d_{ts} &lt; r_p )</td>
</tr>
</tbody>
</table>

**Methodology**

**Limitations of acoustic simulation programs**

- For the STI calculation, a single background noise value is set for the entire room.
- Normally, they do not allow differentiation between useful and interfering sound sources

**Advantages of GIS programs**

- Possibility of automating complex calculations with the data of each of the raster points.
- Multiple geographical calculation options (areas, distances, etc.).

**Case Study**

**Study of the simultaneity of liturgical activities in the Cathedral of Toledo (S XVI)**

According to historical documentation, 30,000 annual masses (100 masses / day)

Analysis of possible activity at 08:00 am