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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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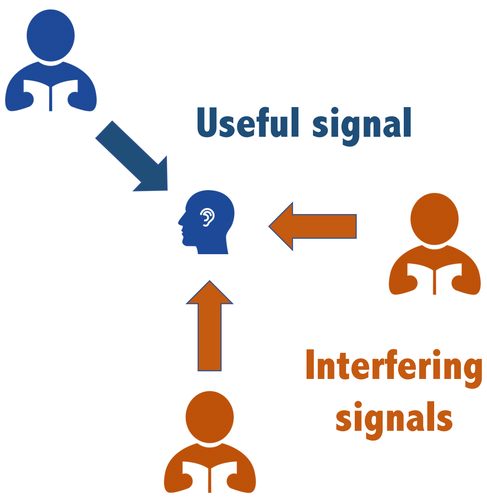
Speech intelligibility in multi-speaker environments



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.

Condition	Distance from target speaker	Distance from interf. speaker
Optimal	$d_{ts} < r_D$	$d_{is} > r_P$
Acceptable	$d_{ts} < r_P$	$d_{is} > r_P$
Unacceptable	Any distance	$d_{is} < r_P$

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.).

Acoustic simulation

- Grid calculation for individual sound sources
- Export SPL an EDT data in 1/1 octave bands

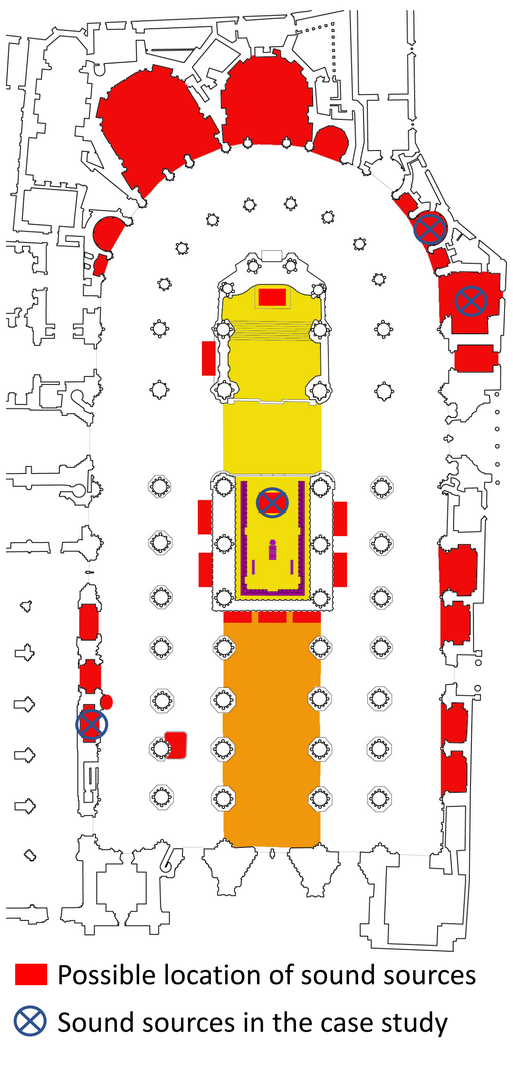
GIS processing

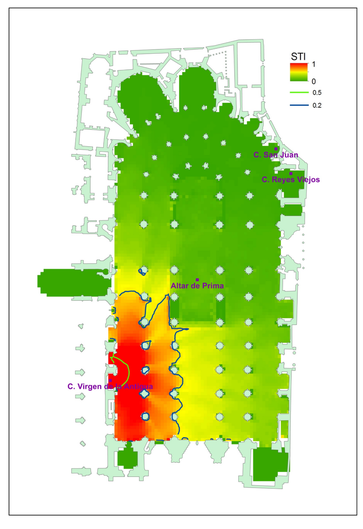
- Selection of target and interfering sound sources
- STI calculation
- Geographical calculations over STI data

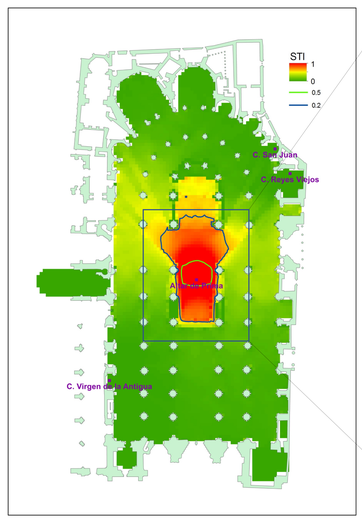
Case Study

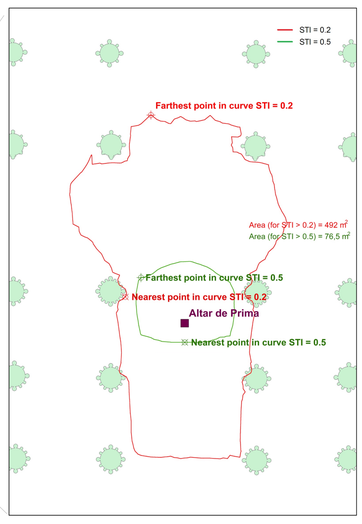
Study of the simultaneity of liturgical activities in the Cathedral of Toledo (S XVI)

According to historical documentation, 30,000 annual masses (100 masses / day)
Analysis of possible activity at 08:00 am









Statistical values for STI = 0,2	
Minimum distance	6,6 m
Maximum distance	21,4 m
Average distance	13,6 m
Standard deviation	4,8 m

Statistical values for STI = 0,5	
Minimum distance	2,0 m
Maximum distance	6,4 m
Average distance	5,0 m
Standard deviation	1,3 m