

The logo for AcMus, featuring the word "AcMus" in a stylized, reddish-brown font. The "A" and "C" are connected, and the "M" is larger and more prominent. The "U" and "S" are smaller and follow the same style.

# **A User-Friendly Graphical System for Room Acoustics Measurement and Analysis**

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# Outline

- Introduction
  - AcMus project
- Measurement Prototype
  - MATLAB
- AcMus Integrated Platform
  - Eclipse (Java)
- Conclusion

# AcMus Project

- Started in 2001 as a research group at USP
- Gathers researchers from different fields (Music, Architecture, Engineering, Physics, and Computer Science)
- Main goals:
  - Study of issues related to estimation, measurement, analysis, and simulation of music rooms
  - Development of a computer software (the AcMus Integrated Platform)

# The Software

- Environment that integrates different tools for acoustic analysis, simulation, and optimization
- Open-source, platform-independent
- 3 modules:
  - Measurement
  - Audio and Acoustic Utilities
  - Simulation and Optimization

# Measurements

- Signal → room response → impulse response → acoustical parameters
- Generates a large amount of data
- We measured 6 concert rooms in São Paulo in order to study subjective parameters related to musical quality

# Measurement Module Prototype

- Set of MATLAB functions
- Provides the MLS and LSF methods for acquiring the room impulse response
- Calculates a number of acoustical parameters from the impulse response
- No special user interface
- Used to process actual measurements

# AcMus Integrated Platform

- Final implementation of the AcMus Software
- A single computer environment for the 3 modules
- Based on the Eclipse Platform and Java
- Current work: implementation of the Measurement Module
- Important goal: provide an efficient and easy-to-use user interface

# Measurement Module

- Hierarchical folders help the user to organize measurements taken from different rooms


















# Folders

- **Project:** represents a room
- **Session:** groups measurements taken at a specific period in time
- **Set:** stores repetitions of the same measurement.
- **Measurement:** stores the audio file of the room's response and the output of the response analysis

# Folders

- ▼  Camargo Guarnieri Auditorium
  - ▶  signals
  - ▶  Session 1 (2005-04-03)
  - ▼  Session 2 (2005-04-03)
    - ▼  SectorA x StageCenter
      - ▶  Take 1
      - ▼  Take 2
        - ▶  ir
        - ▶  recording
      - ▶  Take 3
    - ▶  SectorB x StageCenter
  - ▶  Session 3 (2005-04-11)
  - ▶  project.positions

# Other features

- Wizards for the creation of each kind of folder
- Keeps additional information about folders (date, time, equipment, comments, etc.)
- Signal generator
- Position documentation

# Position Editor

Acmus Perspective - Anfiteatro Camargo Guarnieri - Eclipse SDK

File Edit Navigate Search Project AcMus Run Window Help

Acmus Project Explorer

- Anfiteatro Camargo Guarnieri
  - signals
  - project.positions
  - Teatro de Diadema
  - Teatro Municipal
    - signals
    - Session 1 (2005-08-01)
    - Session 2 (2005-08-01)
      - Balcony x Stage Center
      - Side x StageCenter
        - Take 1
        - Take 2
        - Take 3
    - Session 3 (2005-08-02)
    - project.positions

\*Anfiteatro Camargo Guarnieri

Choose image

Positions

Id	Name	Position
1	Stage Center	(113,35)
2	Sector A	(53,175)
3	Sector B	(177,177)
4	Sector C	(115,316)

■ stage  
■ sector A  
■ sector B  
■ sector C

Floor Plan project.positions

Anfiteatro Camargo Guarnieri/project.positions

# Measurement Interface

- User chooses the signal to be played
- Software plays the signal and records the room response
- Software then calculates the impulse response and the acoustical parameters

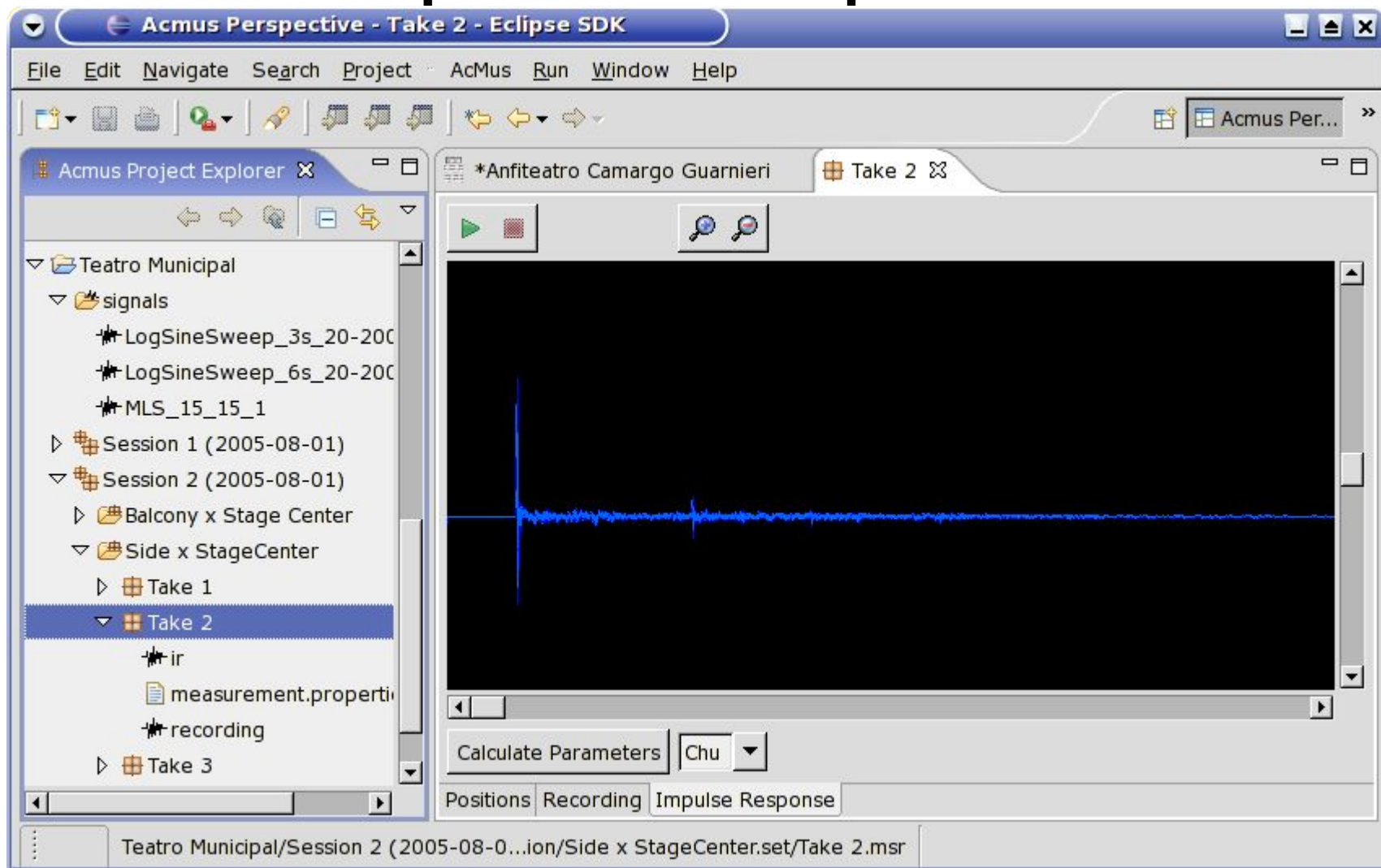
# Recording

The screenshot displays the Acmus Perspective software interface, titled "Acmus Perspective - Take 2 - Eclipse SDK". The interface includes a menu bar (File, Edit, Navigate, Search, Project, AcMus, Run, Window, Help) and a toolbar with various icons. The main workspace is divided into several panels:

- Acmus Project Explorer:** Shows a tree view of the project structure. The "Teatro Municipal" folder is expanded, showing "signals" (LogSineSweep\_3s\_20-200, LogSineSweep\_6s\_20-200, MLS\_15\_15\_1), "Session 1 (2005-08-01)", "Session 2 (2005-08-01)" (with sub-folders "Balcony x Stage Center" and "Side x StageCenter"), and "Session 3 (2005-08-02)". The "Take 2" folder under "Side x StageCenter" is selected.
- \*Anfiteatro Camargo Guarnieri - Take 2:** The main recording window. It features an "Input Signal:" dropdown menu set to "LogSineSweep\_6s\_20-20000Hz.wav". Below this is a play button and a recording indicator. The central area contains two waveform displays: the top one shows the input signal, and the bottom one shows the recorded signal. Below the waveforms are buttons for "Record", "Calculate IR", and "LSF". At the bottom, there are tabs for "Positions" and "Recording".

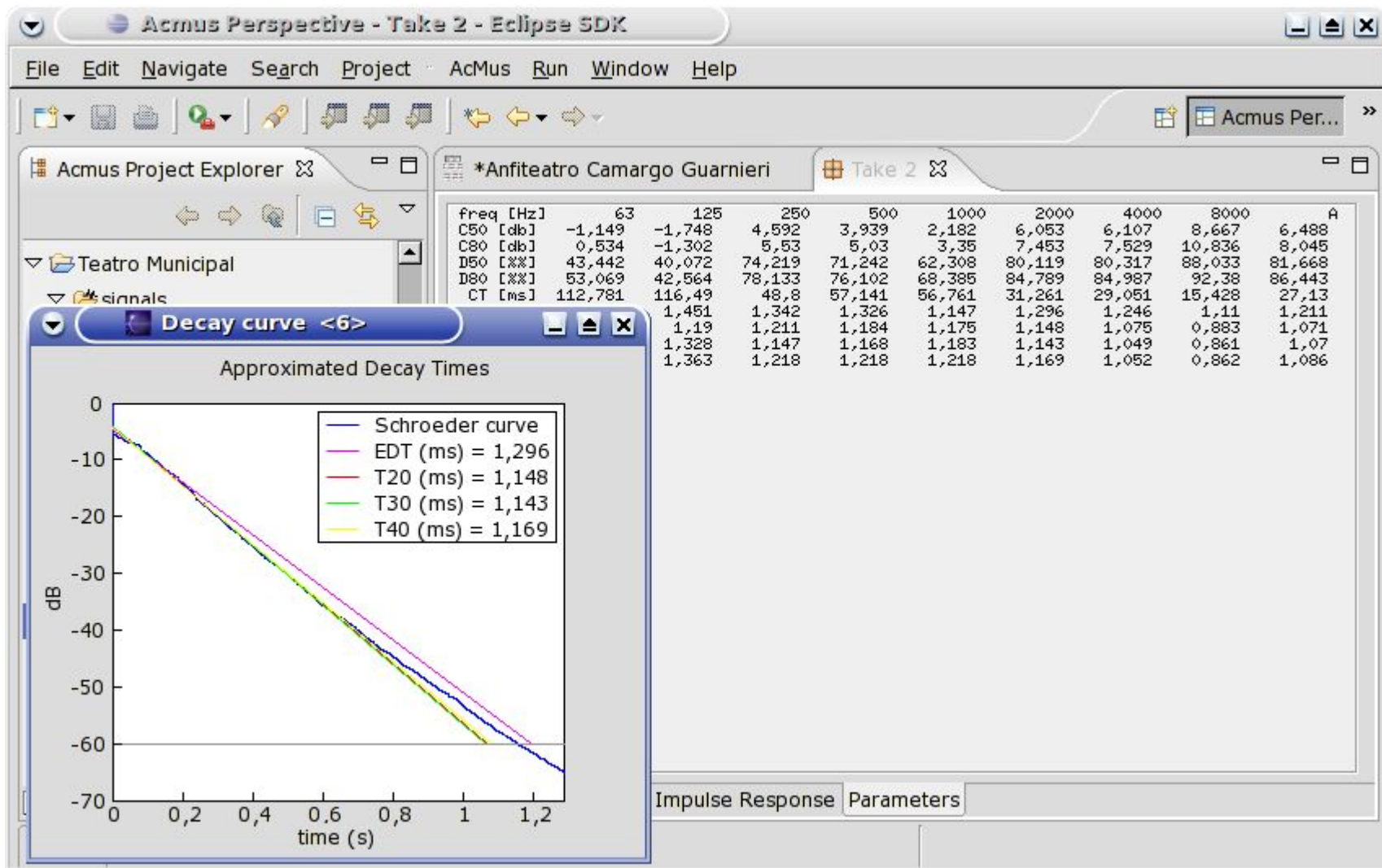
The status bar at the bottom indicates the current file path: "Teatro Municipal/Session 2 (2005-08-0...ion/Side x StageCenter.set/Take 2.msr)".

# Impulse Response





# Parameters

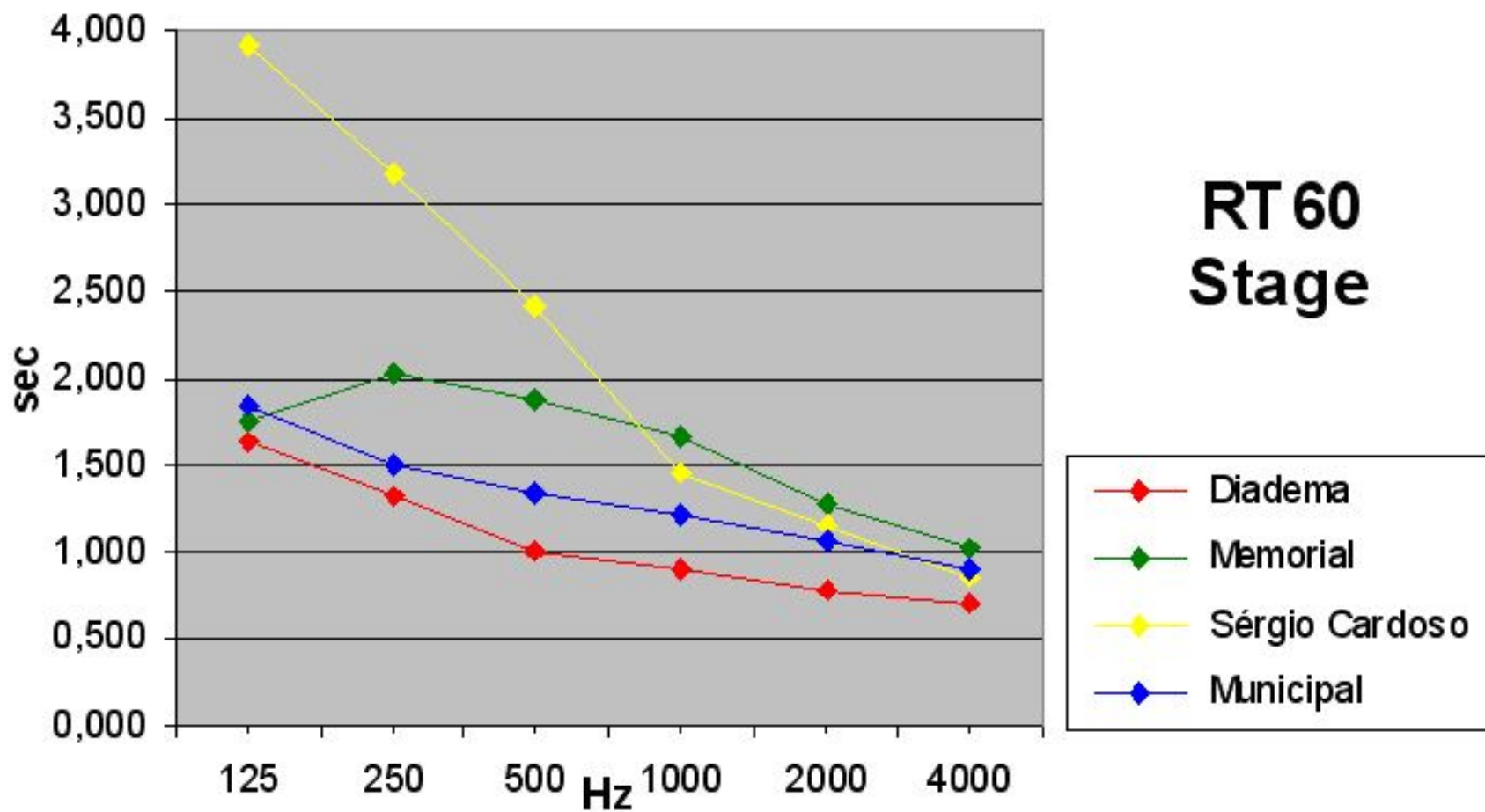




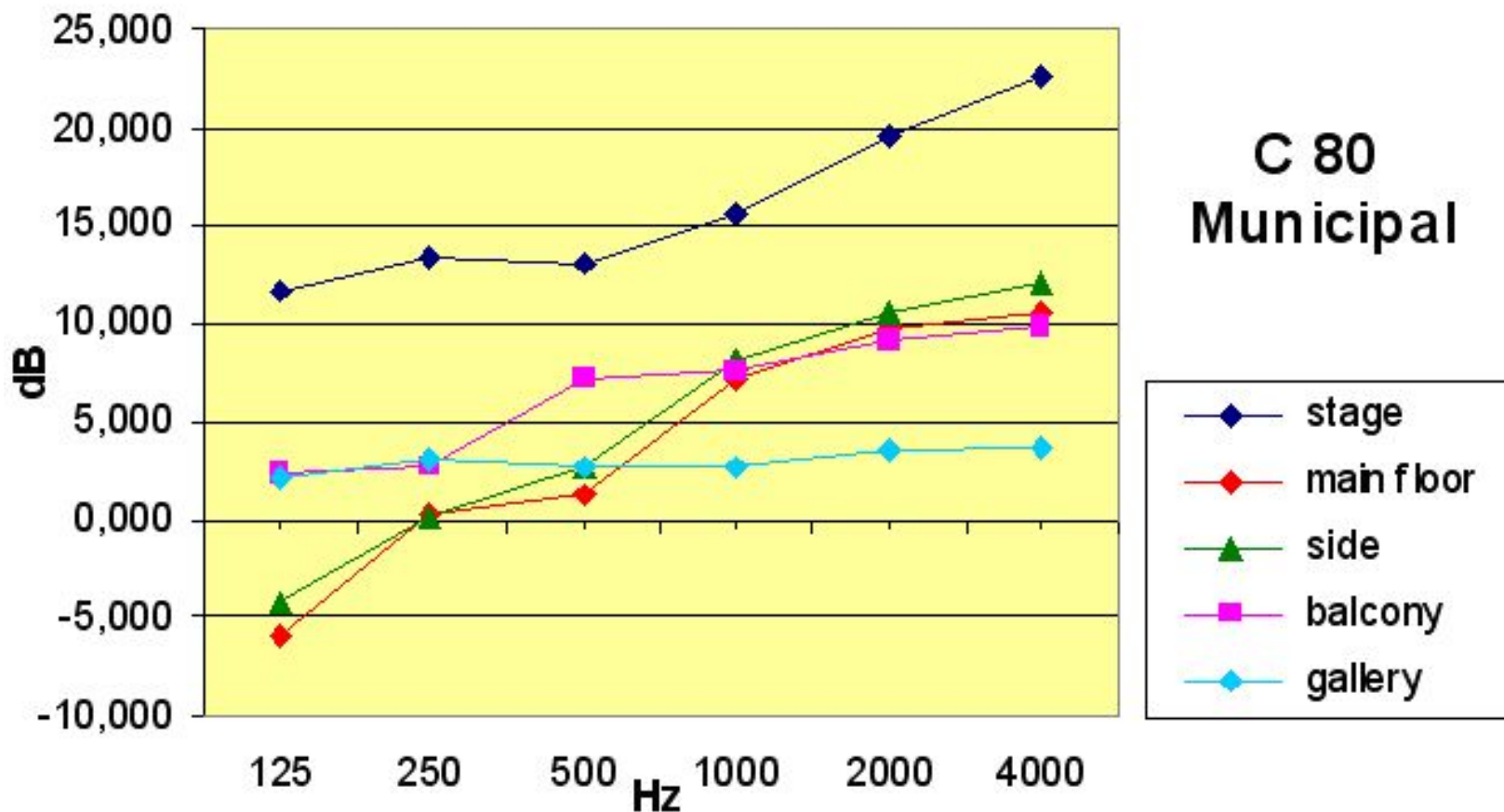
# Work on the field

- Using our prototype, we measured 6 concert rooms in São Paulo where stable symphonic groups perform regularly:
  - Anfiteatro Camargo Guarnieri
  - Teatro de Diadema
  - Teatro do Memorial da América Latina
  - Teatro Municipal
  - Teatro São Pedro
  - Teatro Sérgio Cardoso

# Reverberation Time on Stage



# Clarity – Teatro Municipal



# Ongoing and Future Work

- Performance: implement some of the DSP functions in C/C++?
- Measurement Module user interface enhancements
  - Data visualization
  - Tasks in batch mode
- Work on the Simulation and Optimization Module

# Conclusions

- AcMus currently offers the main calculations and processing tools
- It is freely available and open source
- We welcome collaborators and users from other groups

**AcMus website:**

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