Active Reverberation Systems for Auditoria

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Purpose of R.E.S.

• For practical and economical reasons almost all auditorium are today used for performances which require differing acoustics.

<table>
<thead>
<tr>
<th>Programme</th>
<th>Reverberation time (s)</th>
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</thead>
<tbody>
<tr>
<td>Popular music, jazz</td>
<td>0.8 - 1.2</td>
</tr>
<tr>
<td>Lecture hall</td>
<td>0.7 - 1</td>
</tr>
<tr>
<td>Theatre</td>
<td>1 - 1.2</td>
</tr>
<tr>
<td>Chamber music</td>
<td>1.3 - 1.5</td>
</tr>
<tr>
<td>Opera</td>
<td>1 - 1.6</td>
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<tr>
<td>Symphony Concert</td>
<td>1.8 - 2.5</td>
</tr>
</tbody>
</table>

• Acoustic variability : Controlling RT, spatial impression, early energy, speech intelligibility, …

• Correction of deficient acoustics : Supply energy, Adjusting RT, Early energy
Changing auditorium acoustics

PASSIVE TECHNIQUES

• absorbing (curtains, panels, baffles, …)
• reflecting (panels, movable ceiling or walls)
• orchestra shell

Cumbersome, limited efficiency, costly

ACTIVE TECHNIQUES

• regenerative
• non-regenerative (using electronic reverberators)
Using main R.E.S.

**ADVANTAGES**

- Regenerative systems
  - Rather natural sounding
  - Low disturbance of sound images

- Non-regenerative systems
  - Influence on first reflections
  - Uncoupling SPL / RT
  - Possibly cheaper than Category I
  - Very long RT possible

**DISADVANTAGES**

- Regenerative systems
  - No influence on first reflections
  - Coupling SPL / RT
  - Raise the background VAC noise
  - High number of channels required

- Non-Regenerative systems
  - Disturbance of sound images
  - Uneven stage covering
  - Frequent coloration
  - Disturbing time variance effects
Requirements for new R.E.S.

- **UNDETECTABLE** by listeners (natural sounding)
- Large variation of RT ($\approx +100\%$) in wide frequency range
- Control early reflections
- No disturbance of sound images and orchestra balance
- Inaudible self background noise
- Long term reliability
- Easy to use
- Must not conflict with other equipment (light, …)
Active Virtual Wall Concept

- Few active cells, each composed of a microphone close to its associated loudspeaker, spread around the hall.
- Both acoustic and electronic decoupling used to control cell stability.
- These “quasi-locally” reacting cells behave as active reflectors/diffusers placed on walls and ceiling.
- Reverberation builds up by acoustic interaction between the active virtual walls elements, just like natural reverberation.
CARMEN® - Benefits

- Reverberation enhancement produced by natural energy exchange between the virtual walls elements (no artificial reverberation).
- Space-time coherence of the sound field is preserved.
- Sound pickup from stage is natural (no source image shift).
- Reinforced early reflections (directivity of microphone)
- Virtual positioning of the ceiling and walls.
- No microphone on stage.
Choosing CARMEN®

• **Before ordering**
  - Technical and commercial discussions with the client.
  - Preliminary acoustical study of the room.
  - Definition of the acoustic and technical specifications of the system (number of cells, position, settings...).
  - Technical and commercial proposal.

• **After ordering**
  - Detailed acoustical study or measurement of the room.
  - Decision on the architectural fitting of the cells.
  - Ordering the components and assembly of the system.
  - Cables installation and wiring of the electronic racks.
  - Microphones and loudspeakers installation.
  - Tuning of the system.
Choosing CARMEN®

- **After the installation**
  - Acoustic measurement of the room with the system on the various settings.
  - Musical tests with orchestra.
  - Fine tuning of the system (if necessary).
  - Contractual acceptance tests.

- **Cost between 1.2 MFF and 2.5 MF**