Recording and Reproducing Large Sound Fields

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What is spatial soundfield recording?
Spatial soundfield recording is the process of recording an entire soundfield within a specific region of space.

Intention of spatial soundfield recording is to predict the sound pressure at any arbitrary point inside the given region without the requirement of having a microphone located at that exact physical location.

Where can we use large spatial soundfield recordings?
Recording large indoor areas can be very useful for security purposes, teleconferencing, music and film production.

Spatial recordings of popular sporting events can be reproduced at home using surround sound systems giving the viewer a real life experience.

What are the current approaches to record spatial soundfields and their limitations?
Employing spherical microphone arrays is the most successful approach in recording spatial soundfields.

These arrays comprise of omnidirectional microphones spaced over a sphere enclosing the soundfield of interest.

They are also called as “higher order microphones” where the order is based on the size and the number of omnis being employed.

**Limitations?**
Based on the spherical harmonic representation of a soundfield, as the region of interest becomes larger or/and as the frequency increases, the number of coefficients describing the soundfield becomes larger.

**Recording** is simply extracting these coefficients from the soundfield.

Thus our research problem requires very large spherical microphone arrays of practically infeasible size and geometry.

For example, recording a 500 Hz plane wave field in a spherical region of radius 2m requires at least 375 pressure microphones distributed over an array enclosing the region.

Results

<table>
<thead>
<tr>
<th>Order of microphones being used in the global array</th>
<th>Minimum number of microphones after removing infeasible order</th>
</tr>
</thead>
<tbody>
<tr>
<td>0th order (omnis)</td>
<td>375</td>
</tr>
<tr>
<td>1st order (triple omnis)</td>
<td>54</td>
</tr>
<tr>
<td>2nd order (quadruple omnis)</td>
<td>75</td>
</tr>
<tr>
<td>3rd order (quintuple omnis)</td>
<td>98</td>
</tr>
<tr>
<td>4th order (sextuple omnis)</td>
<td>124</td>
</tr>
</tbody>
</table>

Successful theoretical formulations were carried out for two dimensional and three dimensional soundfields in both interior and exterior field scenarios.

The proposed array’s robustness to noise is currently being studied.

Further simplifying the array geometry to assist practical applications is a topic of future research.

References


Applied Signal Processing Group, College of Engineering & Computer Science, Australian National University.
1 Research School of Engineering, College of Engineering & Computer Science, Australian National University.
2 Australian Research Limited, P.O. Box 31790, Lower Hutt, New Zealand.

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