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COMMON PITFALLS IN COMPUTER MODELLING OF ROOM ACOUSTICS

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1 INTRODUCTION

1.1 With advanced tools, advanced mistakes can be made

The above heading is one of the author's favourite observations by Bengt-Inge Dalenbäck, developer of CATT-Acoustic. Adrian James Acoustics Ltd has acted as distributor and provided technical support for CATT-Acoustic in the UK and Ireland for many years and particularly over the past five years has delivered regular training courses to consultants and academic staff hailing from throughout the UK, Ireland and sometimes beyond. We have always started off the courses with a smattering of such quotations, partly to give the morning caffeine time to kick in before we start on the heavy technical stuff, but mostly to focus the mind and encourage the right approach to using the software. Indeed, the key aim of our training is not only to explore all the technical nuts and bolts of the software but to encourage users to consider carefully how and why they are using the software, what "Geometrical Acoustics" (GA) means, and to take the time to analyse and challenge the results obtained from calculations.

This paper considers some of the common pitfalls and misconceptions surrounding the use of GA-based room acoustics modelling software that we have encountered and offers some general advice on avoiding these. As our day-to-day experience and expertise is with CATT-Acoustic, technical discussion of programme features relates specifically to this software, but general principles will apply to other GA-based software offering similar technical features.

1.2 Understanding limitations

It is worth highlighting that CATT-Acoustic, Odeon and other acoustic modelling programmes employing processes such as image source modelling and variants of ray or cone tracing fall into a family known as "Geometrical Acoustics" (GA) software. This is a term which seems to have fallen out of common usage in recent years but it is usefully descriptive. GA modelling programmes are essentially energy-based and do not solve the wave equation. These therefore offer only approximations of how sound propagates and interacts within a space, based on the geometric features and surface properties of the space. At the core of the GA limitation is that the effect of object and detail size in relation to wavelength is not handled 'exactly', as with wave-based methods, but using approximations. It is important to have a good understanding of these approximations, both in terms of how the calculations work and the limitations of when they apply, which requires a good practical as well as theoretical understanding of room acoustics.

One of the common misconceptions surrounding CATT-Acoustic and other GA software is that such programmes are design tools which require very little specialist acoustic knowledge or time to learn. It is understandable how such a view can arise, particularly if one has experience of loudspeaker modelling tools such as EASE Focus, Duran Audio DDA, or other loudspeaker manufacturers' direct sound array aiming tools, which will perform a lot of clever automatic alignment routines for complex loudspeaker arrays with relatively little input required from the user. It is of course important to appreciate that these types of software are also based on limited simulations; where reverberation is handled, classical diffuse-field theory is often used where it may not really be applicable.