

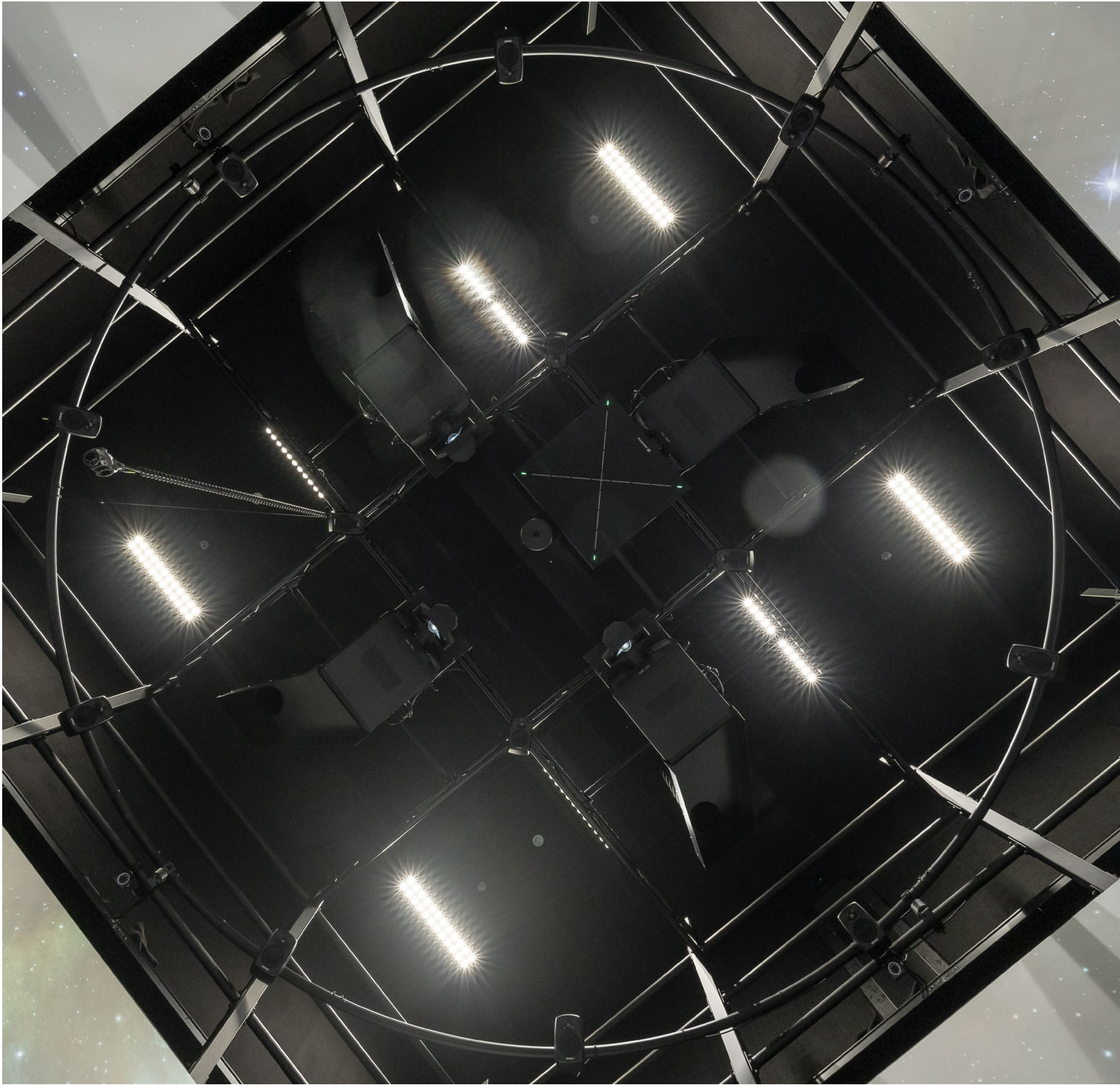
GENELEC®

CASE STUDY

**Genelec assists
in a new age of
collaborative learning
at Tilburg University**

THE DUTCH UNIVERSITY
SPECIALISES IN ARTIFICIAL
INTELLIGENCE, SOCIAL AND
BEHAVIOURAL SCIENCES





**TWO CAVE SYSTEMS DEPLOY GENELEC 4420
SMART IP LOUDSPEAKERS** TO BRING THEIR
VIRTUAL REALITY CLASSROOM TO LIFE



Long days of monotonous desk work are in the past — at [Tilburg University](#) at least — as the Netherlands campus, which specialises in artificial intelligence, social and behavioural sciences, recently upgraded its [DAF Technology Lab](#) to revolutionise the way its students learn and collaborate.

Expanding the possibilities of immersive education and innovative research, two cutting-edge CAVE (Cave Automatic Virtual Environment) systems with VR opportunities and 360° sound from [Genelec](#) now call Tilburg home. In a project that aims to positively impact education and training, the [Smart IP](#) series brought high-quality, real-life audio to a notably complex project.

” THERE MUST BE MUTUAL TRUST, EXCITEMENT, AND ENTHUSIASM ABOUT A PROJECT. THAT’S WHY WE CHOSE GENELEC.

Max Louwerse, Professor of Cognitive Psychology and Artificial Intelligence at Tilburg University — and Founder and Scientific Director of the DAF Technology Lab — has been a big advocate of this new type of immersive learning. In several publications he explained how a CAVE system could be pivotal in the teaching of complex subjects by making them more engaging, motivating, and effective.

In one of the studies Louwerse and his team stated: “Results indicated significantly higher learning gains after collaborative learning in the CAVE with large effect sizes compared to a textbook condition. Furthermore, low spatial ability learners benefited most from the strong spatial cues provided by immersive virtual reality, effectively raising their performance to that of high spatial ability learners.”

Created in collaboration with integrator/designer [Levttec](#) and AV partner [Kinly](#), the DAF Technology Lab presents an all-encompassing VR environment for

researchers and educators. The virtual classrooms were custom built to give the same experience as using a VR headset, with the main difference being that each of the two CAVE systems are completely collaborative. Each has four custom [Gerriets](#) screens on which the virtual world is presented via four Digital Projection projectors, as well as the state-of-the-art spatial sound system from Genelec.

“If we want good visuals, we have to consider good audio,” explains Louwerse. “We looked at loudspeaker companies across the world, and Genelec was our preferred choice. Not only because of the quality of the equipment, but also because of something else that we find important — when we collaborate with a company there must be mutual trust, excitement, and enthusiasm about the project. That’s why we chose Genelec, and they have not disappointed us. On the contrary, we have been extremely happy with the speaker systems in both CAVEs, as well as with the collaboration.”



” THE GENELEC SYSTEM ALLOWS COLLABORATION IN AN EXTREMELY REALISTIC — VIRTUAL — ENVIRONMENT.

The CAVEs each have a system that comprises 42 Genelec [4420](#) Smart IP active networked loudspeakers and two Genelec [7360](#) smart active subwoofers. Each CAVE is a mere five sq-metres in size, so some of the loudspeakers are on the ground, others are at ear height and 10 are placed above the CAVE with an additional four clustered in the middle of the room. The quantity was decided using the Thompson model equation, which calculates how many loudspeakers are needed to ensure that there is minimum space around them.

“Our goal was to create a sound system that was indistinguishable from standing in a real-life environment,” furthers sound designer Marijn Cinjee. “We wanted a system that would allow for sound objects to be moved with high precision in a virtual reality 360° world.”

The team developed a panning algorithm that took data from the loudspeakers to recreate phantom images. Live tracking via

an [OptiTrack](#) passive tracking system ensures that the listener never moves outside the zone of immersion, as it can follow a maximum of 12 people at once in the CAVE by tracking bodily and facial movements.

“The main purpose of this project was realism, and also for the human voice in the simulated environment. The Smart IP series turned out to be cost effective because you don’t need all the other infrastructure, such as extra cabling and additional amplifiers — the power, audio and loudspeaker management all run off a single CAT cable,” explains Cinjee. “The DAF Technology Lab is also a very modern space, so we couldn’t resist the temptation of going with a modern audio solution.”

Additionally, the spatial system is run on a [Digigram](#) audio card that sends signals to all 42 channels and uses an AES67 network to access the Smart IP loudspeakers. This is run through a [QSC](#) audio processor which handles all of the channels and makes sure that the latency is consistent, and all software



is aligned. Furthermore, the CAVEs use Ableton software to address the channels and move the sound in 3D.

“Each speaker is equally spaced — and therefore perfectly calibrated,” continues Maarten Horden, who designed and developed the DAF Technology Lab. “When you walk around the space you will experience a different way of listening depending on where you are standing, but it is always the most optimal sound. This is all thanks to Genelec.”

One of the main challenges with the DAF Technology Lab was that the two CAVEs weren't big enough for back projection, but this became a positive when it came to installing the loudspeakers. “We designed the CAVE ‘inside out’ with front projection, which gave us the advantage of placing the speakers behind the screen,” explains Horden. “If you had back projection, the audio system would have created shadowing.”

Tilburg's DAF Technology Lab CAVE systems have presented the university and its affiliated partners with a new age of both technology and teaching. The system utilises high-quality, immersive technology to positively impact the way students respond to complex information, and Genelec has again played a key part in what looks to be a pivotal project for future collaboration both on and off campus.

“Whereas most CAVE and VR environments focus on impressive immersive visual aspects in simulations, the DAF Technology Lab combines an impressive 360 degrees immersive visual simulated environment with a cutting-edge immersive audio environment,” notes Louwerse in conclusion. “The Genelec system has provided us with unprecedented opportunities to have groups of users interact with learning content and collaborate in an extremely realistic — virtual — environment.”



THE KIT

Each of the two CAVEs contains:

- 42 x 4420A
- 2 x 7360A