

# Sound judgement

Premium sound systems in some makes of car can cost more than €5,000. When the customer is paying that much, there is a lot of pressure on the companies involved to make sure it sounds as possible.

But the inside of a moving vehicle is an appalling space for good sound reproduction. It helps that premium cars have better than average NVH performance, but the driver still sits in an inconvenient off-centre position, different trim materials absorb and bounce sound in unequal measure and the people in the rear have the speakers that should be behind them directly to their sides.

The ultimate test of a sound system is subjective – there's no real way of quantifying how good a system is. Steps are being taken to develop simulation software that will give companies the chance to start developing the systems earlier without a final vehicle, but, for the moment, could this be one of the few areas where there really is no substitute for the human touch – or ear?

Bowers & Wilkins supply the audio system to the Jaguar XF. They do use simulation for the audio system, but know that it can only take them part of the way.

"Simulating audio quality at the moment is mostly analysis of loudspeaker cones and cabinets," says automotive business manager Martin Lindsay. "CAD systems can model car doors, vibration and so on, but we don't think it's that useful in modelling the acoustics of the car interior because there are so many variables for trim, fit, finish and vibration. It's too much effort to get what amounts to only a very rough idea."

The alternative is a trained listener who can work out issues with a sound system just by sitting in the final vehicle. This person will identify what adjustments need to be made to give you the perfect sound-stage, where all the instruments appear to be coming from the front centre of the car.

But the reason why simulation is desirable in any field is because it allows you to work with systems before you have physical parts. One of the biggest problems for audio companies working with cars is that the window in which they can work with a final product is so small. And prototypes or body in white mock-ups have such different characteristics from the finished production-ready car that the tuning will likely have to be completely redone.

Dolby works with several carmakers. The first steps happen three to four years before the vehicle enters the market when the manufacturer and supplier will decide what features they want the system to have, and then create a mock-up of the vehicle interior.

"It'll likely be something that exists in a previous vehicle and speaker locations will pretty much be finalised," says Dolby sales manager Simon Arnold. "Six months before the vehicle launches, the audio

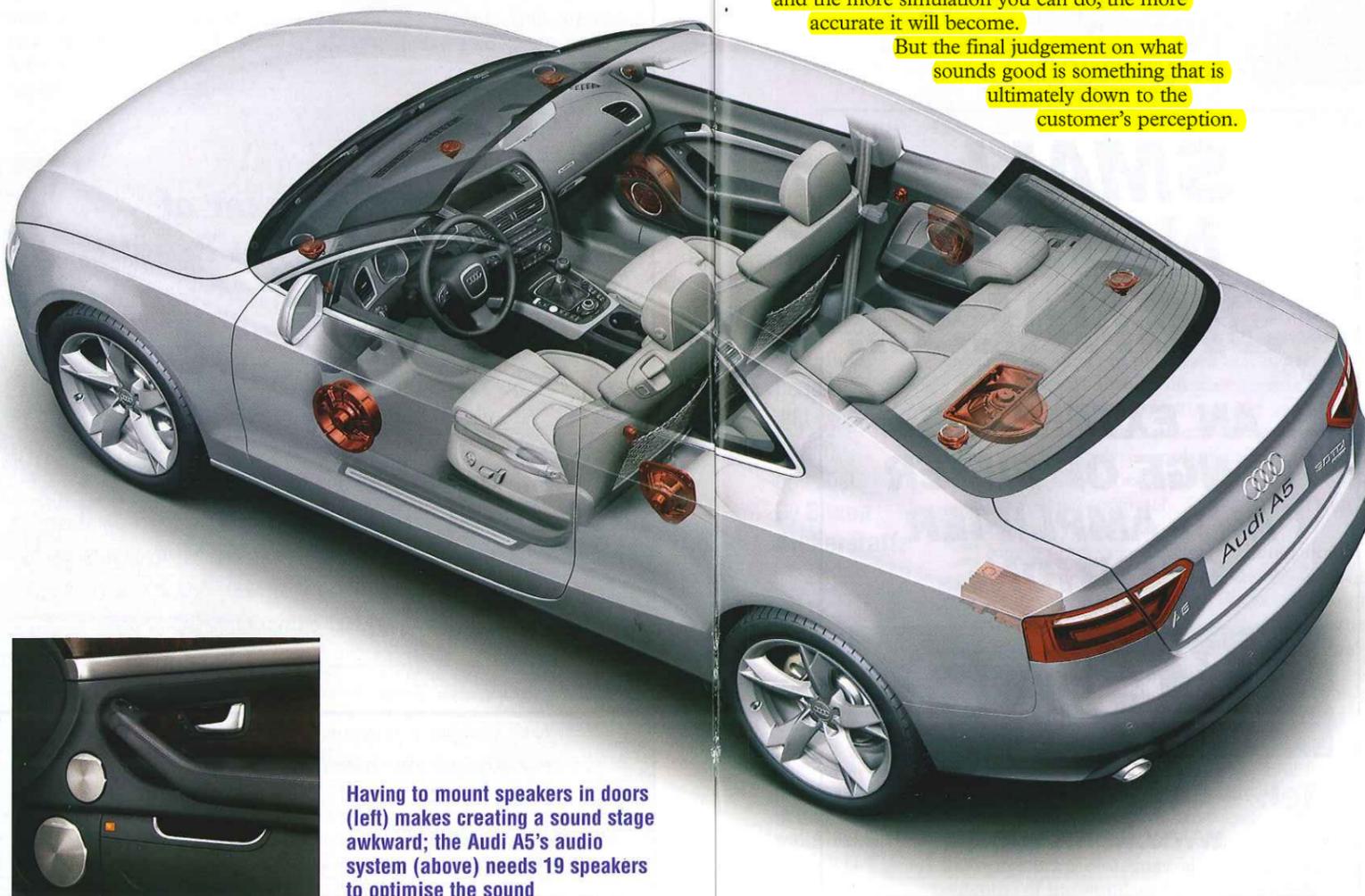
Computer simulation can solve near-impossible calculations, but there are still areas where it can't solve with humans. Audio is one of them, reports **James Griffiths**

manufacturer will try to get hold of an almost production-ready vehicle, but the first lot of hand-built models won't be as good build quality as the final models, and they won't use the same grade of materials inside."

"This is an area that Harman Kardon been working on in detail. Over the past ten years the Mercedes supplier has built up tools that can help to an extent with understanding what sort of affect the different materials and obstacles in the car may have on the car's audio.

"We use a system simulation tool that allows us to predict how the seats, materials and other content in a car enclosure will affect audio," says sales director Tony Harberman.

By checking the simulated measurements against the actual cars, the simulation is becoming increasingly useful. "We continue to refine it," says Harberman. "It's never perfect, but it does allow



Having to mount speakers in doors (left) makes creating a sound stage awkward; the Audi A5's audio system (above) needs 19 speakers to optimise the sound

you to get closer to the end result more quickly. But at the end, however, we're still using subjective evaluation."

For Bang & Olufsen, who provide the top-end systems used by Audi, this evaluation and final tuning will be done by a specially trained tonmeister, who is responsible for sitting in the finished car and making the adjustments to find the perfect sound.

"My goal is to ensure the cars are as good as possible in terms of their sound quality, so actually working in the vehicle is essential," says Bang & Olufsen tonmeister Natanya Ford. "The sound the listener gets in the vehicle depends on so many things that you have to be in the vehicle to get the best result and experience."

The aim is a curious blend of the subjective and objective. There is a definite aim that Bang & Olufsen is looking to achieve, but it will be Ford's ears, and those of a group of listeners, that decide if that has been met.

"We aim to get what's on the music disc into the car with nothing added or taken away," says Ford. "It's not subjective. We don't want to add extra warmth, or bass. We give the customer controls so that they can adjust it to their preference, but we just want to make the reproduction of the disc perfect."

The overall picture from the audio companies is that in the future, there is a desire and opportunity to use more tools on aspects of audio simulation, and the more simulation you can do, the more accurate it will become.

But the final judgement on what sounds good is something that is ultimately down to the customer's perception.



Drivers get a front-row seat audio experience

## Phantom tweeters kill audio costs

Premium sound systems are well and good for premium vehicles, but audio technology company Arkamys is taking cost out of mid to low-end sound systems by using software to recreate high quality sound with fewer speakers.

By configuring the software algorithms that dictate the timing and "placement" of sound coming from the main door speakers, high frequencies can be thrown up to the windscreen of the car, creating the desirable front "sound stage". This means the small, high frequency tweeter speakers can be removed, saving up to €1-2 per vehicle.

"This solution makes most sense for tier-one suppliers of car audio units that do not have specific audio software skills," says sound processing engineer Yann Lecouer.

The algorithms in an audio system can be tuned to cause fractional delays between when a sound is played in the left and right speakers. This can be used to ensure that a driver, sitting in an off-centre position, still gets both sounds arriving at the same time, recreating the sense of being sat in the perfect "sweet spot", or it can fool the brain into believing the sound comes from elsewhere.

Sound-staging, the process of making all music appear to come from the front of the car, offers the most realistic reproduction of most recordings.

Because it is a software solution, carmakers do not need to install any additional equipment or hardware and the tuning can be done quickly and adapted to individual systems.

Arkamys is aiming specifically at the mid and low-range French market and has signed a contract with an as yet unnamed manufacturer.

It is working with Magneti Marelli, which specialises in navigation and audio units and supplies PSA Peugeot Citroën. Arkamys' demonstration vehicle was a Peugeot 308.