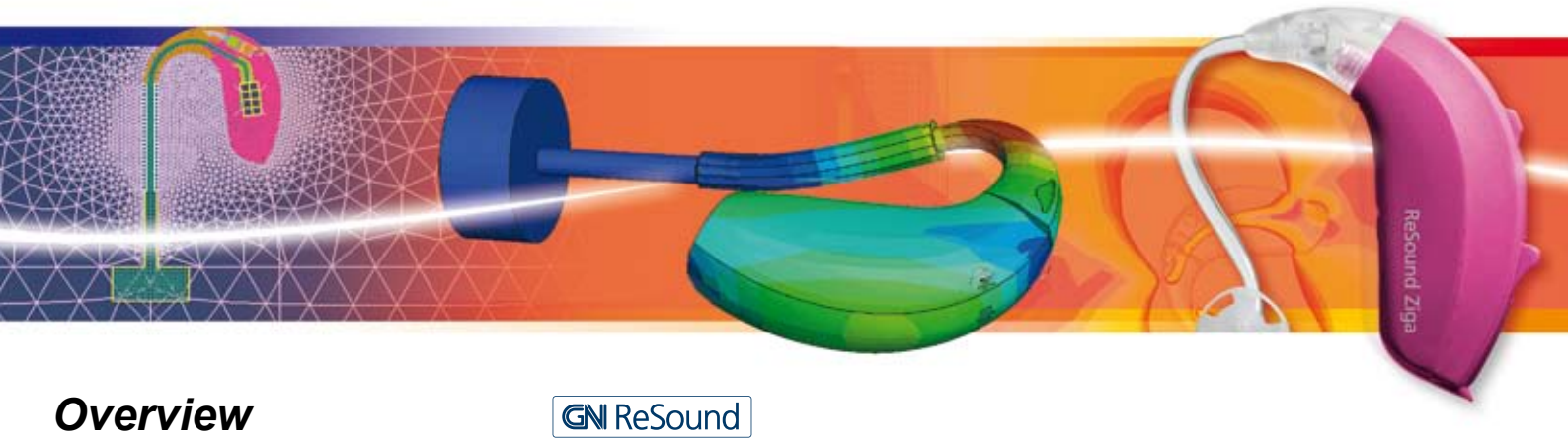
GN ReSound

Optimizing hearing aid performance with realistic simulation solutions from SIMULIA



Overview

Challenge

GN ReSound needed to improve its development process that was greatly influenced by a trial-and-error approach with a faster, more precise method for measuring and visualizing sound and vibration behavior

Solution

GN ReSound uses Abaqus FEA software from SIMULIA to simulate the realistic behavior of its hearing aid devices

Benefits

SIMULIA's solutions helped GN ReSound improve hearing aid performance while shortening development time

"Today we're using Abaqus FEA for the most acoustically challenging of our hearing instrument products to evaluate geometry, materials, and performance. Once we have a working model, we then optimize it to make it even better before it goes into production."

Morten Birkmose Søndergaard
Senior Acoustic Engineer
GN ReSound

GN ReSound

Providing innovative solutions to help those with hearing loss

The GN ReSound Group is one of the world's largest providers of hearing instruments and diagnostic audiological instrumentation. The 4,500-employee strong company based in Copenhagen, Denmark, has a high-tech acoustics laboratory where engineers perform design, analysis, and testing of hearing instruments that aim to improve quality of life for people with hearing loss.

Hearing aids have come a long way from the mechanical devices such as 18th-century ear trumpets and speaking tubes. Early electrical hearing aids used heavy batteries and provided limited sound amplification with poor to moderate fidelity. Technological advances led to progressive miniaturization of devices during the 20th century so that today's hearing aids are extremely light and comfortable to wear, but designing hearing aids remains an acoustic challenge.

The acoustic challenge stems from the fact that the distance between the microphone and the receiver (or loudspeaker) inside a hearing aid is only two to three millimeters, and this can easily cause feedback. "We try to produce up to a 90 dB gain between a microphone and receiver, which can be compared to designing a 2-3 mm thin wall between a normal working office (~40 dB SPL) and a loud rock band (~130 dB SPL) next door without increasing the noise level in the office," said Morten Birkmose Søndergaard, senior acoustic engineer at GN ReSound. "Going beyond the feedback limit results in the amplified output from the receiver looping back into the microphone, causing the instrument to squeal. This fundamental performance limitation must be accounted for in every hearing aid design," he added.

Replacing trial-and-error with virtual simulation

Just a few years ago, numerous hearing aid prototypes were physically tested in

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GN ReSound's lab. Modifications to the design and composition were made according to the results. GN ReSound essentially used a trial-and-error approach, which made development times long and fastidious. In addition, designers were confronted with technical challenges such as assessing the hearing aid's feedback path, which consists of many parameters that can be difficult to measure accurately with traditional equipment. To obtain a more precise, less time-consuming approach to measuring and visualizing certain vibro-acoustic behavior, GN ReSound chose Abaqus FEA software from SIMULIA. By opting for a design and virtual testing approach based on realistic simulation, the company can ensure the stability of device designs, improve hearing aid performance, and experiment with new materials and geometries.

Simulating real-world conditions

To make the simulation models of all the critical elements of a hearing aid, GN ReSound engineers import 3D CAD geometry into Abaqus. Then they use Abaqus to define the simulation model attributes, apply the finite element mesh, run the simulations, and visualize the results. Abaqus enables the engineers to model the behavior of critical connections, such as that between the steel receiver housing and the rubber tube that goes over the receiver sound port. Once the simulation model is set up, GN ReSound engineers compare and validate the readings with real-world data such as vibration velocity, sound pressure levels both inside and outside of the hearing aid, and use acoustic holography in both two and three dimensions. Engineers then adjust components, geometry, and materials in their models for better stability (no feedback or squeal) and maximum sound gain.

Improved performance and faster development times

"We now have a better understanding of what causes instability and, as a result, can eliminate these causes in the early design stages," said Søndergaard. "This leads to improved device performance, shorter development times, and the need for fewer physical prototypes."

"Today we're using Abaqus FEA for the most acoustically challenging of our hearing instrument products to evaluate geometry, materials, and performance. Once we have a working model, we then optimize it to make it even better before it goes into production. Then, using our existing simulation data, we can give our researchers advice and guidelines for developing future designs," concluded Søndergaard.

> "With the realistic simulation solutions from SIMULIA, we have improved device performance, reduced development times, and need fewer physical prototypes than before."
>
> **Morten Birkmose Søndergaard**
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