

# Widex Enhances the Development of Hearing Aid Technology with 3D Direct Modeling

*As an industry leader and a dedicated, hearing aid innovator — Widex was the first with a digital in the ear hearing aid — the company is driven to continue to leverage technology in the development of new hearing aid solutions. Significant expertise and creativity is infused into every tiny hearing aid sold to consumers. One of the primary reasons Widex's technology has been so influential and successful is because of the rigorous and thorough analyses that the products undergo prior to market introduction.*

*The American Academy of Audiology estimates that 36 million Americans require hearing aids, and as the Baby Boomers age, the number grows rapidly. The need for quality products that enable improved hearing and clarity has never been higher and thanks to companies like Widex, the time and effort being invested in perfecting the technology has never been greater.*

## ABOUT WIDEX

Widex is a world leader in digital hearing aid technology. The company's hearing aids are sold in more than 90 markets around the world, with 97 percent of their products exported from the country of origin in Denmark. Founded in 1956, Widex employs over 2,000 worldwide, 900 of whom are located in Vaerlose, Denmark, where Widex research, development and administration are based. The company has captured a 10 percent global market share and is the sixth largest supplier of hearing aids in the world.



## THE 3D DESIGN CHALLENGE

*Quickly and Efficiently Prepare Models for Analysis*

Mads Jakob Jensen is a development engineer who has been working with Widex for more than three years. His primary function is to develop and improve hearing aid designs. With most BTE (behind the ear) models, the electronics on the outside of the ear connect to a mold on the inside via a tube. Inevitably, a small amount of sound tends to leak out from around the mold, lessening the effectiveness of the hearing aid generated sound at the eardrum, and potentially interfering with the exterior microphone, causing grating sounds for the user.

*"My job is to analyze current models and newer designs to determine what has worked well and what needs improvement," said Mads Jakob Jensen, Development Engineer, Widex*

Mads uses COMSOL primarily for analysis of acoustics and vibrations to optimize the hearing aid performance. As part of the process to prepare the model for analysis, he must simplify the existing design, which is sent to him in one of many CAD formats. Mads is not a CAD expert, and when he received the existing designs, he had to send them to the design department to be de-featured and simplified so that he could perform what-if analyses. This process was very time consuming, which forced lengthy and frustrating delays before he could proceed. In some cases, CAD compatibility issues hindered his ability to perform a complete analysis.

## WIDEX UTILIZES SPACECLAIM FOR MODEL PREPARATION

Mads chose SpaceClaim® as a solution to cut down the time to analyze a single piece of geometry. Despite not being CAD-trained, Mads is more than capable of doing all the necessary design and prep work with these

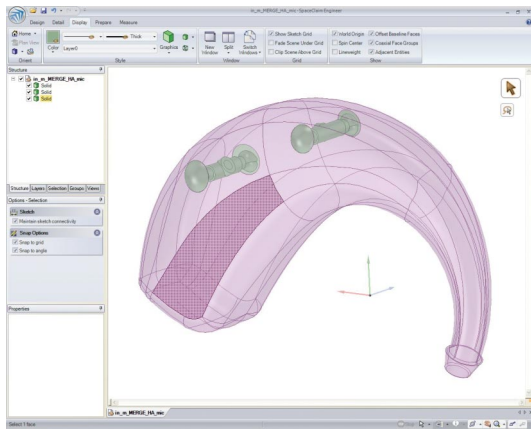
models using SpaceClaim's flexible and easy-to-use 3D Direct Modeling software. With SpaceClaim, he can bypass the design department, streamlining the process and reducing cycle time.

Mads now has the ability to spend more time analyzing and improving hearing aid designs and less time preparing and transitioning, enabling him to fully utilize his skills and creativity. More time is spent evaluating the advantages and opportunities to improve each hearing aid model and less time waiting for the models to go through CAD systems to be prepared for analysis.

*"Before I started using SpaceClaim, I had to depend on other people to be sure I got my job done, now I can do it all myself."*

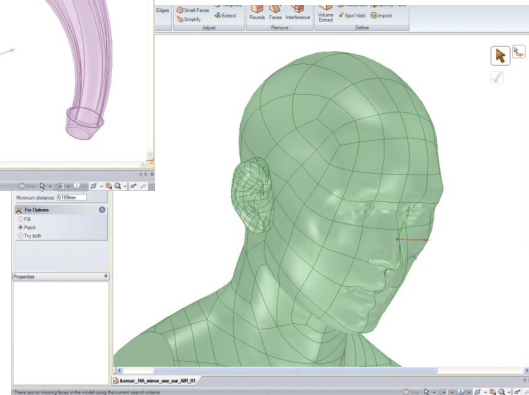
Mads Jakob Jensen

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**Figure 1** CAD drawing of the Inteco IN-m hearing aid including details of the microphone inlets.

**Figure 2** The Widex Inteco IN-m hearing aid placed on the ear of the KEMAR manikin.



### COMSOL AND SPACECLAIM

#### *Enable Widex to Respond Faster to New Hearing Aid Design Opportunities*

Once the model is prepared in SpaceClaim and ready for analysis, Mads uses COMSOL Multiphysics' PDE mode and transfers the results to a specialized simulation and algorithm development environment that Widex assembled built on MATLAB. The equations used in these studies are not standard in most commercial simulation software, but integrate with COMSOL Multiphysics to enable Mads to study the acoustic model of the ear and optimize the design of the hearing aid. These algorithms permit optimization of everything from the location of the microphones on each hearing aid to the location of miniature vents that reduce low frequency sound at the eardrum.

*"Our work is based mostly on thermoviscous acoustics, which is composed of numerous equations that are not commonly found in simulation software. Because COMSOL Multiphysics enables us to input our own equations, it has been essential to our studies."* Mads Jakob Jensen

Prior to using COMSOL, the algorithms used for these procedures were based on experimental measurements gathered from lab tests that didn't capture all of the complexities required to adequately analyze the hearing aids. COMSOL enables Mads to study more details that are difficult to acquire experimentally, including radiation from the ear mold and internal structural vibrations.

All of this development leads to the ultimate goal of creating the most efficient device for helping people enjoy and fully utilize their sense of hearing. SpaceClaim perfectly complements COMSOL to prepare models for performance-intensive analyses. Mads is able to quickly ready models without being bogged down in the complexity and compatibility issues inherent with traditional CAD systems. After performing analysis and design edits, Mads is able to provide a final model that specifies the detailed design in CAD, eliminating time-consuming back and forth processes and expediting time-to-market.

*"Often I had models for analysis we couldn't get to at all because it took forever. Now, I am saving at least 10 man hours per model analyzed and I am able to get results more quickly than I had anticipated."*

Mads Jakob Jensen  
Development Engineer, Widex



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