

*A screen shot from the Visible Ear Simulator 2.0. VES 2.0 will feature an advanced physics engine that allows users to interact with bone structures and soft tissue in real time.*

*We have also integrated cutting-edge research from the computer game industry to achieve high visual impact and make the simulation a truly immersive experience.*



## VES – VISIBLE EAR SIMULATOR

VES is a surgical simulator that allows surgeons to train complicated operations in the temporal bone. By using advanced 3D graphics and a so-called "force feedback" pen, it is possible to simulate a drilling operation in the temporal bone.

Drilling procedures in the head are associated with many risks. Among other things, the surgeon may injure the facial nerve with the drill and cause the patient permanent facial nerve paralysis. Therefore, surgeons need to be thoroughly trained. VES has been developed by the Alexandra Institute with surgeon Mads Sølvesten Sørensen, MD at the Ear, Nose and Throat Department at Rigshospitalet, and it is used now by leading surgeons worldwide.

To develop a realistic simulator, it is important to be able to display lifelike colours as the surgeon often makes vital decisions based on the visual impression. Mads and his team have therefore produced "The Visible Ear" data set that is unique both with regard to resolution and quality.

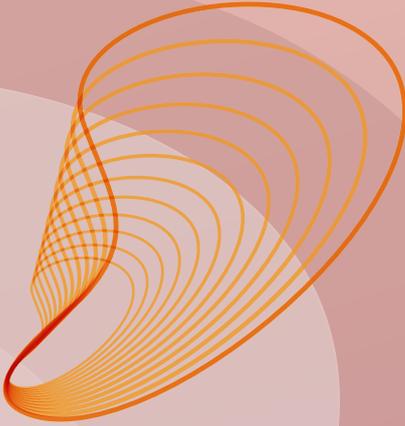
The data set consists of more than 500 colour images obtained by a method called cryosectioning, where a segment (in this case the head of a deceased woman) is frozen and then cut into very thin layers, each of which are digitally photographed.

### TECHNOLOGY

To use this massive data set for real time visualisation, it has been necessary to develop advanced volume rendering algorithms that can generate an accurate representation of the different anatomic elements with regard to shapes, colours and transparency. In addition, focus has been on reproducing a realistic sensation of the drill interaction with the bone via the force feedback technology, as the tactile drilling experience is very important for the success of the simulator.



# VES



## VISIBLE EAR SIMULATOR



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The Alexandra Institute's Computer Graphics Lab has particular focus on e.g. photorealistic rendering, surgical simulation, visualisation of massive data sets, acceleration of data-intensive computations on modern graphics processors and physics-based animation.

Read more about the activities in the lab on [cg.alexandra.dk](http://cg.alexandra.dk) or contact Head of Research and Innovation Jesper Mosegaard.

The Alexandra Institute brings the latest IT research in use and creates innovative solutions in collaboration with industry and research. We are one of Denmark's nine members of GTS, a network of independent Danish research and technology organisations. The aim of GTS is to promote the development and deployment of the latest knowledge in Danish companies.