

Final Performance Report

Contract # **FA9550-08-C-0006:**

Hearing Protection for High-Noise Environments

Period of Performance: **Oct 01, 2007 – Nov 30, 2009**

Attachment 5

CONSTRUCTION OF THE HUMAN HEAD MODEL

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Summary

A precise model of the cochlea and its vicinity is essential for reliable numerical simulation which could discern between different mechanisms of energy transfer to the human ear.

Therefore, a significant fraction of our effort was devoted to the construction of a sufficiently detailed and anatomically faithful model of the ear (its outer, middle, and inner parts). The model we constructed consists of the following parts:

1. the outer ear represented by its exterior surface, the surface of the auditory canal including the tympanic membrane, modeled as a finite-thickness surface;
2. the middle ear, modeled as a surface of the system of ossicles and supporting structures;
3. the inner ear, modeled as a set of surfaces representing the boundaries of the cochlea, the vestibule, and the semi-circular canals;
4. the skull, described by the surface of the bone;
5. the outer surface of the skin surrounding the skull; and
6. a homogeneous material filling the space between the skull and the inner ear.

For tests of noise-protection devices, we also included a model of a helmet and the material layer filling the space between the helmet and the surface of the head.

We stress that all the geometry components: skull, skin, inner, middle, and outer ear, as well as the helmet, are mutually compatible and matched to one another.

Some representative examples of the geometry details are presented in Figs. 1 to 8.

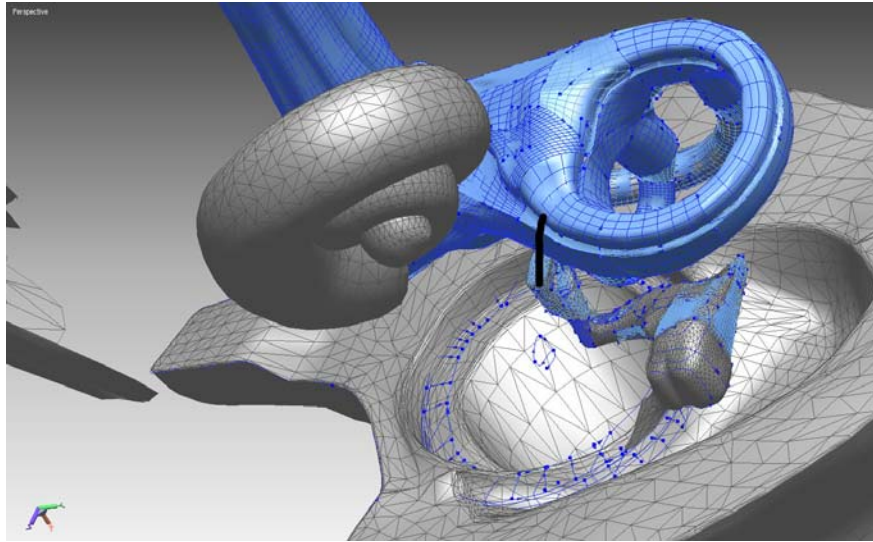


Figure 1: A part of the inner ear structure: the cochlea and the semi-circular canals.

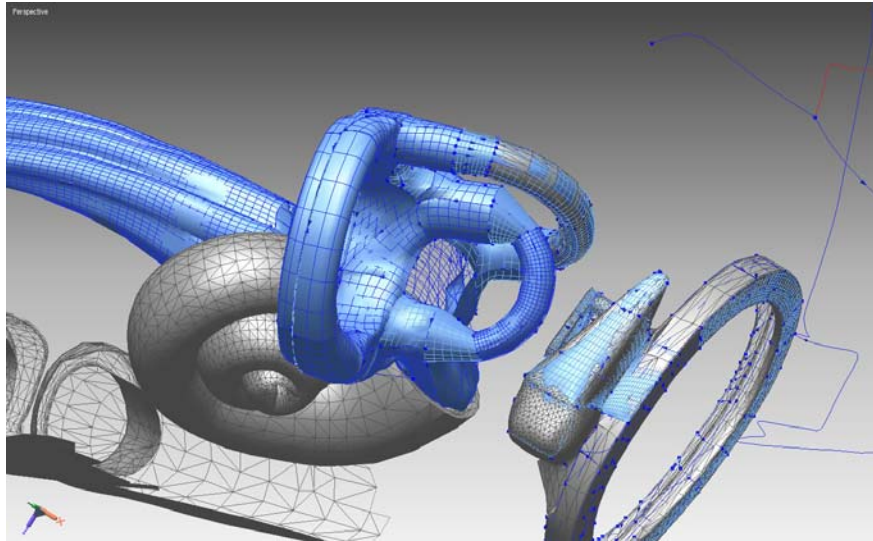


Figure 2: Another view of the cochlea, the semi-circular canals, and the adjacent structures.

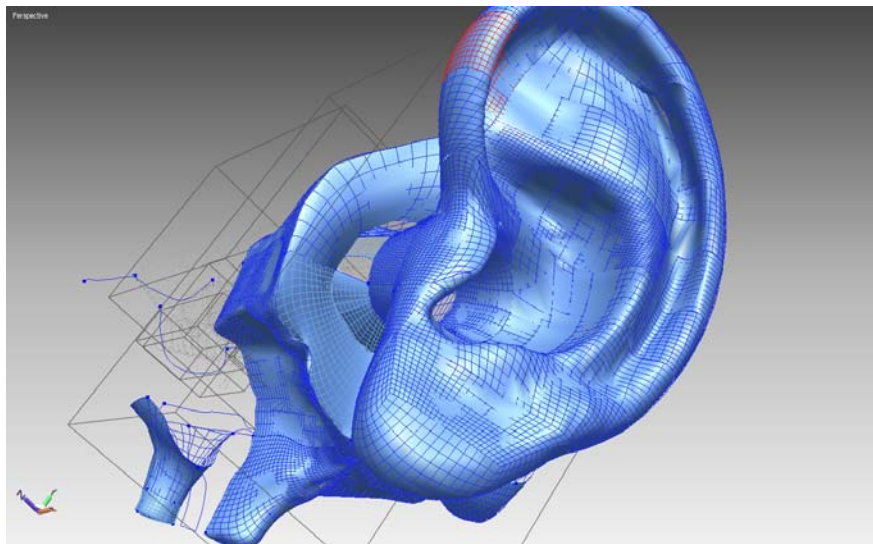


Figure 3: A view of the outer ear and the adjacent part of the skull.

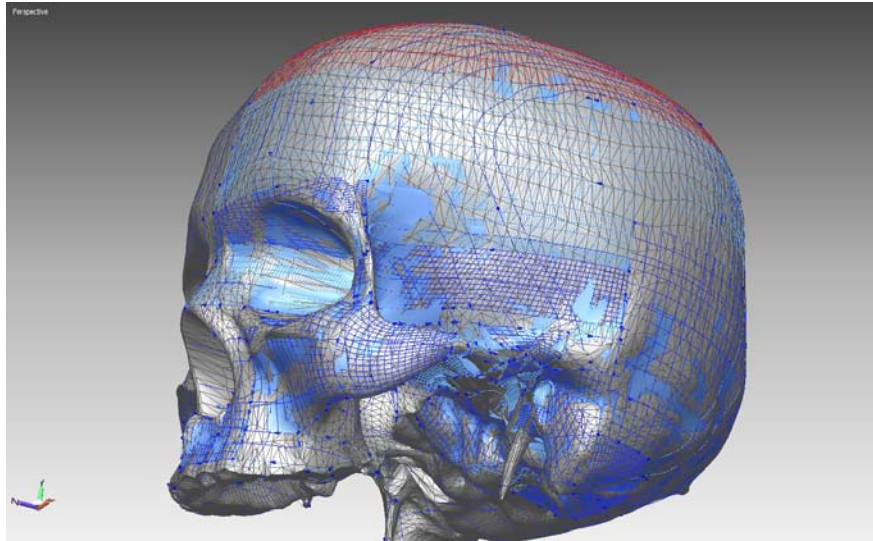


Figure 4: The overall view of the skull model.

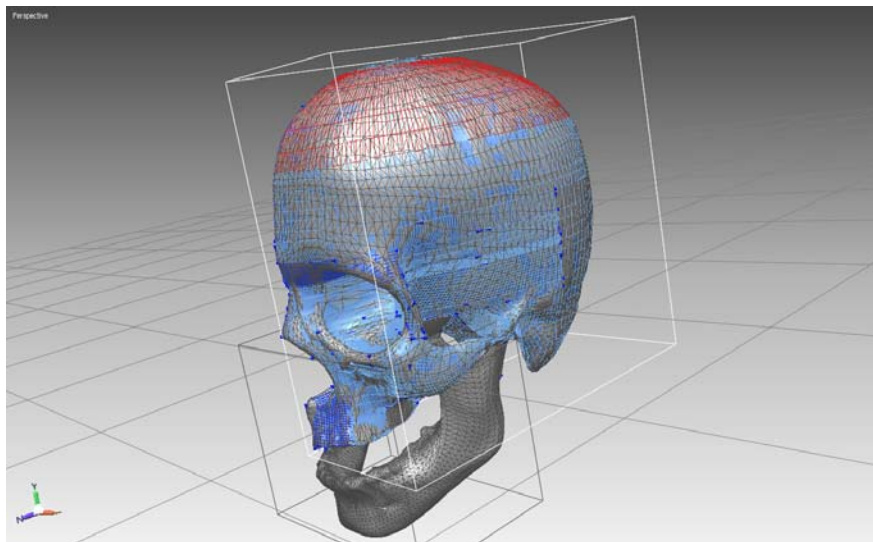


Figure 5: A view of the skull model, including the lower jaw.

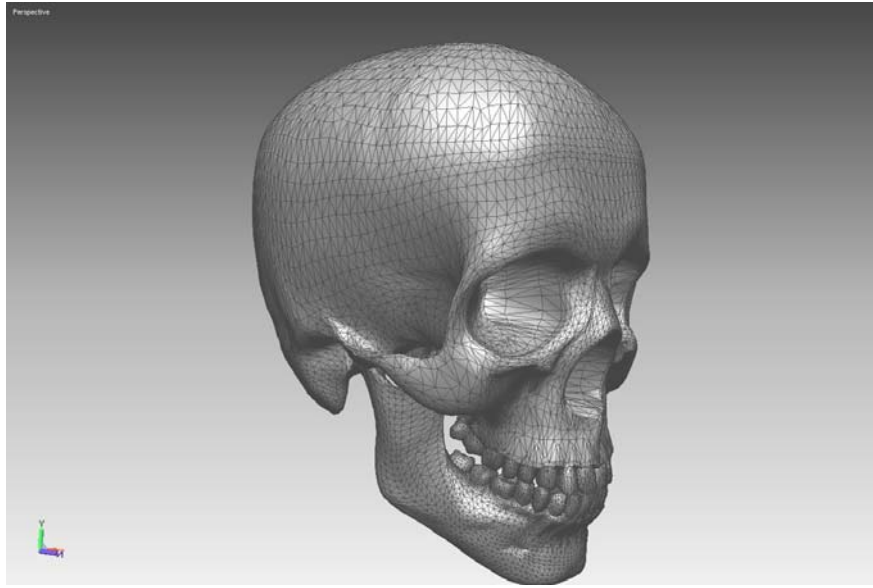


Figure 6: Another view of the complete skull model.

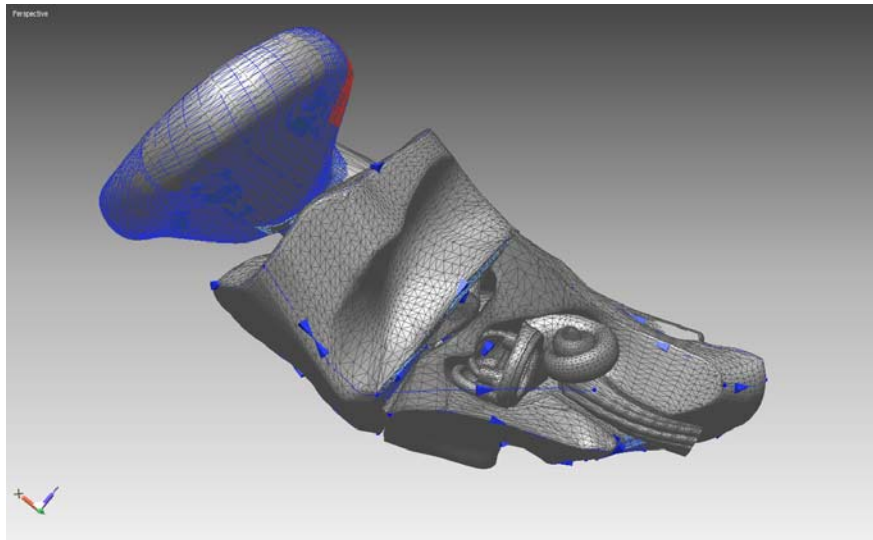


Figure 7: The outer ear and the inner ear structure embedded in the skull bone.

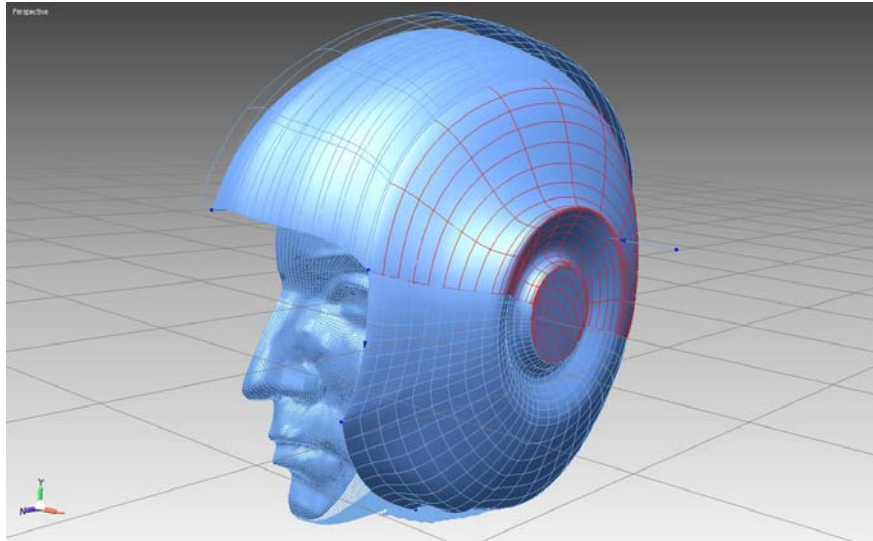


Figure 8: The model of the head skin surface and the matched helmet.