# Biomedical researchers reduce need for human testing with 3D printed model

PhD student Sossena Wood and Prof. Tamer Ibrahim from the University of Pittsburgh created a life-size phantom head using Somos® WaterShed XC 11122 to test the effect of electromagnetic waves on biological tissue. It is helping to make bioengineering R&D faster, more efficient and less reliant on human testing for applications like MRI scanning and medical implants.

*"The head phantom, made using the Somos® material, has been a tremendous aid for designing and speeding up the development of electromagnetic devices like the MRI antennas we've recently developed. It's proven to be very useful"*

Associate Professor, Tamer Ibrahim

## Executive Summary

### Customer

Department of Bioengineering, University of Pittsburgh

### Challenges

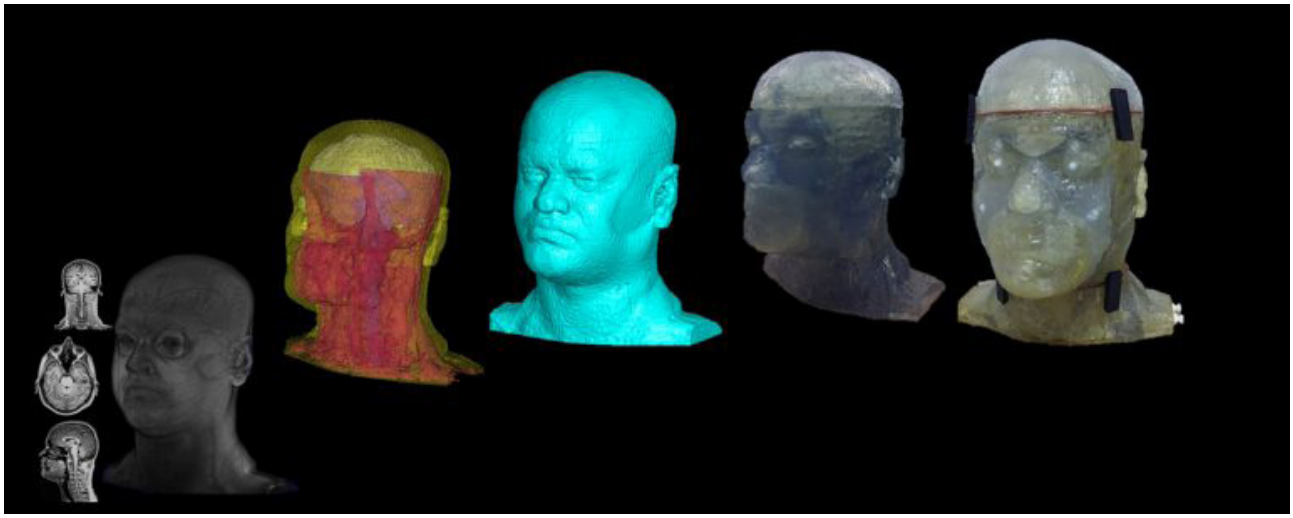
- Use bioengineering to advance medical R&D
- Reduce the need for human testing
- Reduce time and cost bringing new treatments to market

### Solution

- Somos® WaterShed XC 11122

### Benefits

- Enables fast, low-cost testing for medical and bioengineering processes and devices
- DSM material is highly comparable to human tissue
- Delivers valuable R&D information for bioengineering, neuroimaging and neuroscience



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## Challenges

Medical research and development is seeking new and innovative ways to combat diseases and improve the lives of people around the globe. One way they approach this is through the vital field of bioengineering. Bioengineering develops new equipment and processes essential for research, diagnosis and delivery of healthcare treatments.

Recently, the Department of Bioengineering at the University of Pittsburgh in Pennsylvania began working to gain vital insight into the human body. One of their primary missions is to be a leading biomedical research and development center, in particular electromagnetic equipment used in non-invasive imaging such as Magnetic Resonance Imaging (MRI).

Testing is typically done with basic phantom models, computer simulation or, in some cases, on humans under highly regulated but also very restricted conditions.

### Advantage of DSM Additive Manufacturing materials

*"The concept was to use the liquid material to represent internal human tissue, so the model needed to be hydrophobic and not absorb liquid like some plastics do. Somos® WaterShed XC 11122 has several characteristics that made it ideal for this project. It's clear, durable and water resistant, but also has similar conductivity properties to averaging the conductivity of fat, bone and skin making it a good choice for creating the phantom head."*

Sossena Wood, PhD bioengineering student

The Radiofrequency Research Facility (www.rf-research-facility.engineering.pitt.edu) at the University of Pittsburgh wanted to find a way to make testing faster, safer and more flexible and came to a conclusion to use 3D printing as a solution. Tamer Ibrahim, Associate Professor in the Department of Bioengineering - in collaboration with his mentee PhD bioengineering student, Sossena Wood - thought of and implemented the innovative idea of creating an anatomical human head phantom. It is a physical model representing human anatomy characteristics that is electromagnetically equivalent to a human head.

## Solution

Phantoms are used to analyze, evaluate and calibrate systems and instrumentation prior to conducting tests on humans. They allow researchers to understand the phenomena of the interaction of electromagnetic waves and biological tissues. Most existing phantoms, however, do not support complex, sophisticated testing such as high-field electromagnetic waves where interactions are difficult to measure and interpret.

The first step was to scan a healthy volunteer's head using an MRI scanner to create a 3D-digital image. The data was then used to produce a computer-aided design (CAD) of the head, broken down into several segments, from which a 3D, life-sized model was made using stereolithography (SLA) technology. The team chose Somos® WaterShed XC 11122 as the material for the project for its ability to produce durable parts with fine details and its conductivity which is similar to the human body.

Using the SLA process allowed refillable ports to be incorporated into the model so that different liquid materials, designed to represent the characteristics of human tissue, can be injected into various organs. The phantom head helps to speed up the design and testing of new equipment and techniques dramatically. It also improves safety as initial testing no longer relies on the use of actual humans. This allows the team in Pittsburgh to push the limits of testing further than they could with human subjects.

### Real-life application

*"Computer and numerical simulations are an important part of the testing process, but they are more of an approximation. The phantom head created using DSM Additive Manufacturing technology, on the other hand, complements these techniques. It lets you go further by mimicking what happens in a real-life environment. It is also more accessible and cost-effective than getting a subject or cadaver."*

Sossena Wood, PhD bioengineering student





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