Human Dielectric Equivalent Model

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Problem Statement

Honeywell (The Client) needs a way to test new RF electronics on a model that simulates the dielectric properties of the human body. Information security is a big concern which is why the transmitted information needs to travel through the body instead of being openly transmitted. The Client is looking to expand beyond the limited scope of possible human testing through the use of a physical equivalent. There is not an industry standard for the frequency bands used, so the model would have to be accurate over a large range of frequencies or specific models would have to be used for specific frequencies.

Deliverables

The Client has tasked our group with creating a physical model that closely simulates the human body's dielectric characteristics. The Client has specifically asked for a model or models with dielectric equivalency in the 3 kHz to 100 kHz, 10 MHz to 20 MHz, and 150 MHz to 600MHz bands that can sustain hot and cold temperatures unsafe for humans. The models will be used to test electronics that use the body as their transmission path to decrease the chance of having the transmitted information intercepted. The ideal transmission path is from one hand, up the arm, through the torso, and down the other arm to the other hand. Software models like the VHP model shown in Figure 1 will be used to verify results.

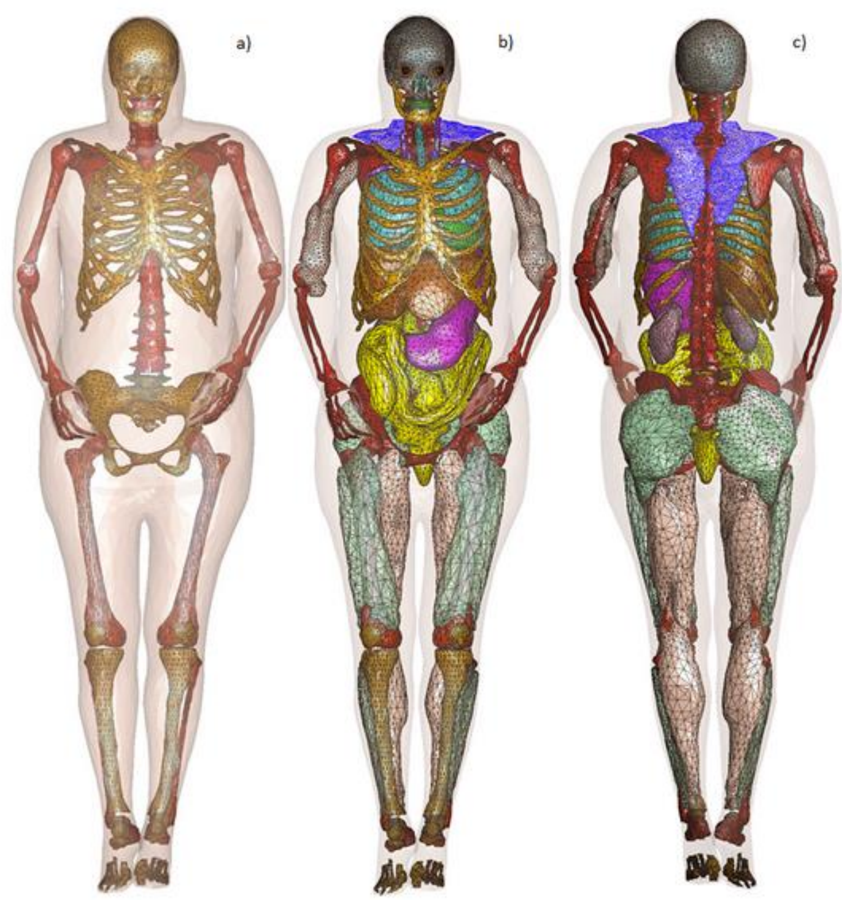
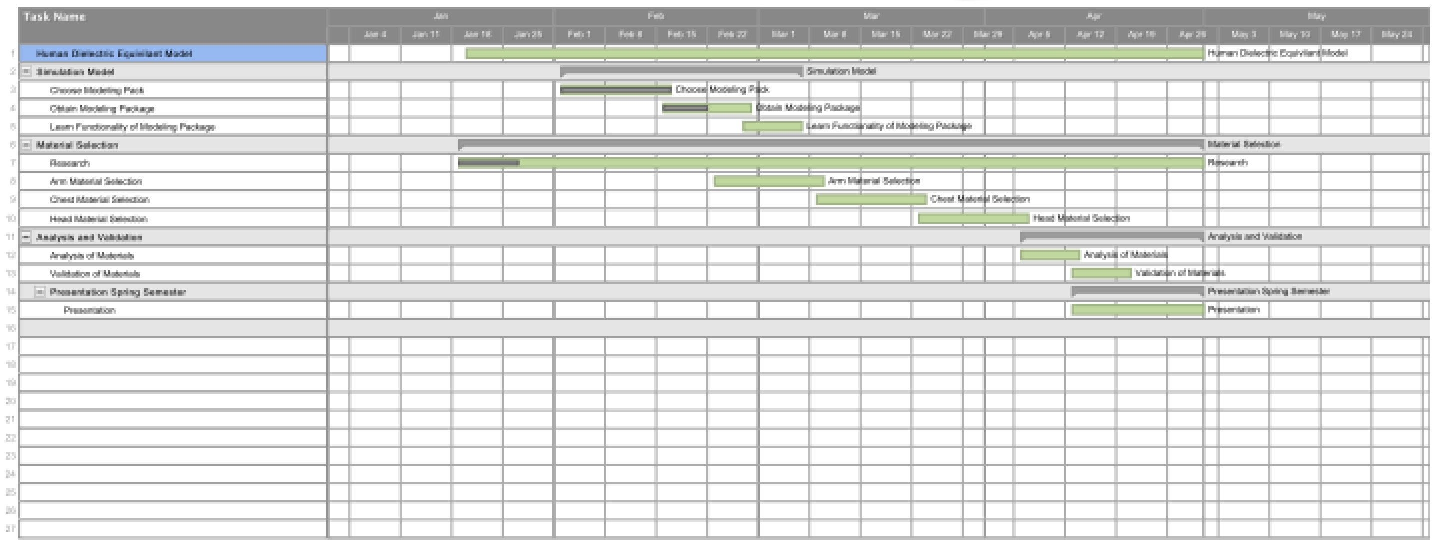


Figure 1: The images above are from the NEVA Electromagnetics VHP Female Computational Phantom 2.0 and they show female bodies created in triangular mesh networks used to simulate electromagnetic properties of the human body

Timeline

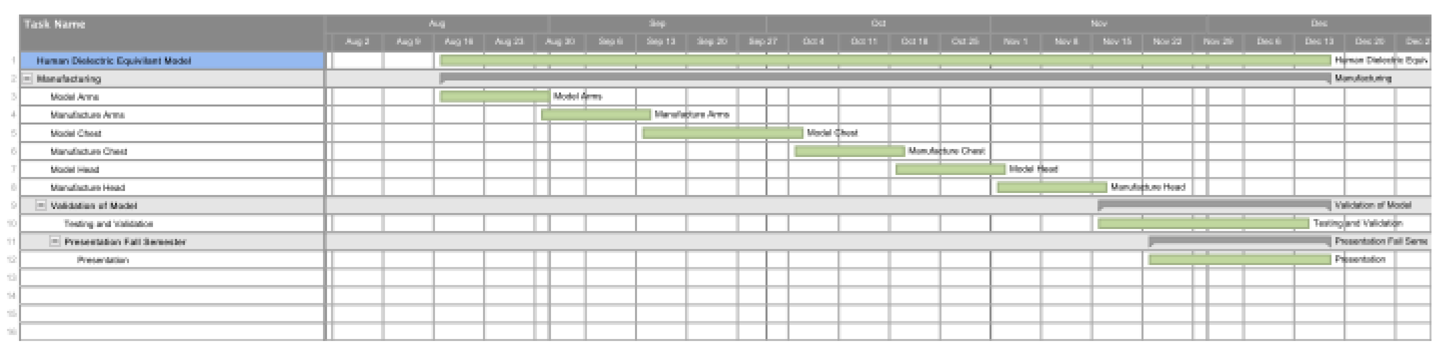
First Semester:

Project Timeline



Second Semester:

2nd Semester timeline



Design Alternatives and Possible Solutions

- One possible alternative would be to use a computer model and run computer simulations to test the frequencies. The problems with this is the computing power needed to for these simulations. It may be beneficial to use a non-graphical simulation so we know what to expect from the physical model. One advantage a computer model has is the ease to change proportions of body tissues since this would have effects on the electrical properties. However using a computer model will produce limited results constrained to how we set up the simulation where a physical model has potential to produce a wider range of information.
- Another solution would be using a cadaver to test the different frequencies. This has obvious problems as we would need to account for the difference of the properties of dead and living tissue as well as procuring a cadaver could present certain legal challenges.
- Another possible solution would probably be to use non-graphical simulations on already existing computer models to simulate the effects of these different frequencies using varying proportions of body tissue to help create a more accurate physical model.

Costs

TBD

Risks

- Not meeting client's needs
  - The client already has a physical model at their disposal. Our physical model will need to exceed/outperform the one the client already has. If our model does not meet these requirements then our model will be more or less useless.

- Budget
  - Our client has given us a $500 budget to work with. This will most likely not be enough due to the exuberant cost of licensing fees for software and the cost of the materials that will make up our physical model.

- Licensing
  - We could run into issues with non-disclosure agreements as well as our client not being able to obtain the software we used to test our model because it may or may not be available for commercial use.

- Accuracy of our model/software simulation
  - The accuracy of our model is very important to the success of our project. Obviously the more accurate our model is the better but we could run into limitations that force us to reach a point of limiting returns. We could also run into the problem that the materials we chose only have a certain maximum accuracy. When it comes to the software simulation accuracy we will have to have faith in the people who developed the software that their measurements and calculations are accurate because that is outside of our project scope.

- Software availability
  - Some software that is capable of running our desired simulations is super expensive and not in the budget of our project. Also some software that is available for research/universities may not be available for commercial use.

- Materials
  - Our model will have to use materials that are durable but yet inexpensive. They will also have to match certain properties that the human body exhibit. Another problem could be getting probes/leads into the material in order to test the model against the software simulation results.

- Lab Availability
  - Gaining access to the labs we need in order to test our materials could prove to be a problem. Certain labs have the equipment needed to test our materials but they could either be locked or have a class going on in them.

Conclusion

In a world where information security is becoming an ever-increasingly difficult task, we aim to create a human model equivalent that can be used to test electronics that keep data safe. It is unknown at this time if one physical model will provide good results across the three bands in questions, or if three physical models will be required.

References

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