

ECE 290: Senior Design Fall 2006
Electromagnetic Phantom for the Human Body

Project Statement

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Statement of Need:

In the past, the military has utilized communications that consisted of one soldier in a squad carrying a bulky antenna pack to keep in contact with headquarters. To move more efficiently in the field, antennas were soon integrated into the equipment that a soldier already carried, such as within body armor. With this evolution a new problem arose. The human body affected the properties of the antenna, and therefore a systematic way of testing body-worn antennas needed to be created. This was done last year by a senior design group sponsored by MegaWave Corporation. The final product was an automated system that through the use of a source antenna, body worn antenna mounted on a dummy, and a network analyzer, measured the antenna properties for a 360 degree rotation of the dummy. The dummy was filled with a saline solution that possessed similar electromagnetic properties to the human body.

As body worn antennas further developed, the need for a more accurate phantom arose. While the saline solution acted similar to the human body, it was determined that it was not precise enough for MegaWave's research. Therefore, a new solution is needed that more closely represents the electromagnetic properties of the human body. This would provide more accurate results when developing body-worn antennas, allowing them to be more efficient.

Preliminary Requirements:

This solution should be designed so that it better represents the electromagnetic properties of the human body than the previously used saline solution. The solution must be accurate for a frequency range of 20 MHz - 3000MHz. Also the solution with which

the phantom will be filled should be stable, that is, it will not separate over time or due to small changes in temperature. The code for the automated testing system should be modified so that graphs are automatically created after taking a measurement, as well as a way to easily compare the phantom test results with the human test results. The final solution must be tested using the revised automated testing system developed last year for MegaWave Corporation.

Basic Limitations:

It should be noted that very precise electromagnetic phantoms of the human body are available but are very expensive, in the tens of thousands of dollars in cost, and therefore our solution should be cost effective. The solution utilized should be able to be mixed in a timely fashion, so that a phantom can be prepared for testing in a single day. In the case that the optimum solution cannot be removed from the phantom, it should be able to be transported manually.

Questions:

What is the mixing proportion of the previously used saline solution?

Should a weight limit be considered for the fully filled phantom?

What are the skin depth, dielectric constant, loss tangent, and other various electromagnetic properties of a human body in the frequency range?

What programming language should be used to modify the code?