SAND2014-16018D

Trailer Electromagnetic Simulations and Modeling

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Georgia Institute of Technology
PhD in EE, Dec 2016

iSAFE
Interns for Security, Arms control and Force protection Engineering

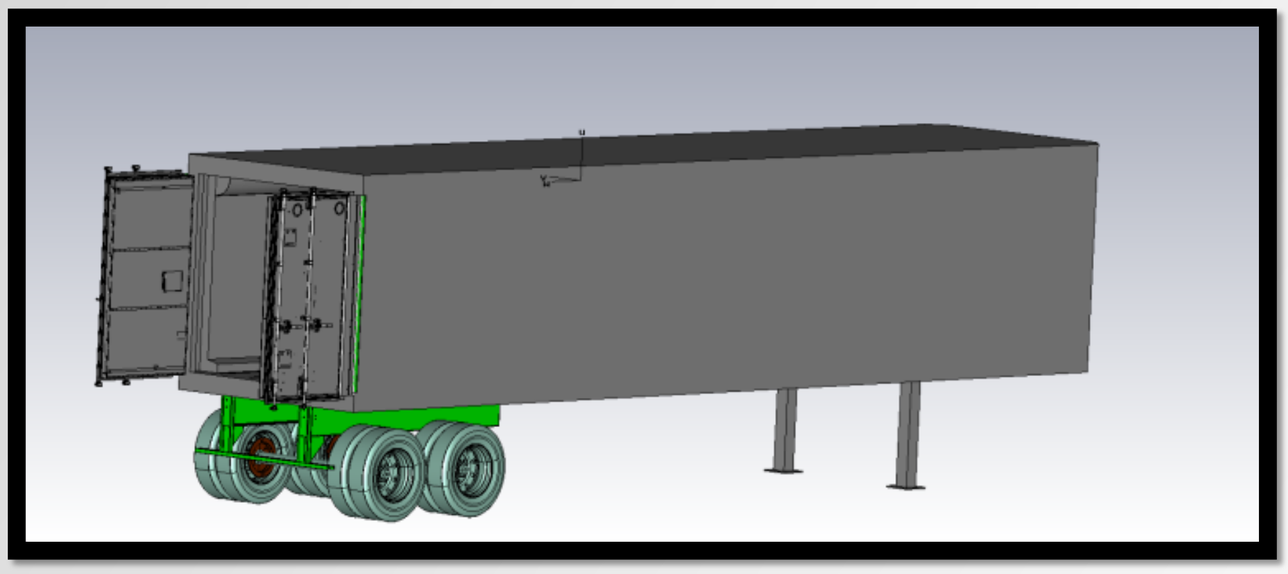
Manager:
Shawn Taylor
6612/6613

Project Mentor:
Paul Haddock, 6622

Under project lead Paul Haddock of 6622 (Communication and Electrical Systems Technologies), most effort was devoted to RF related tasks. Most of this work involves electromagnetic simulations with a transportation trailer using the software CST Microwave Studio.

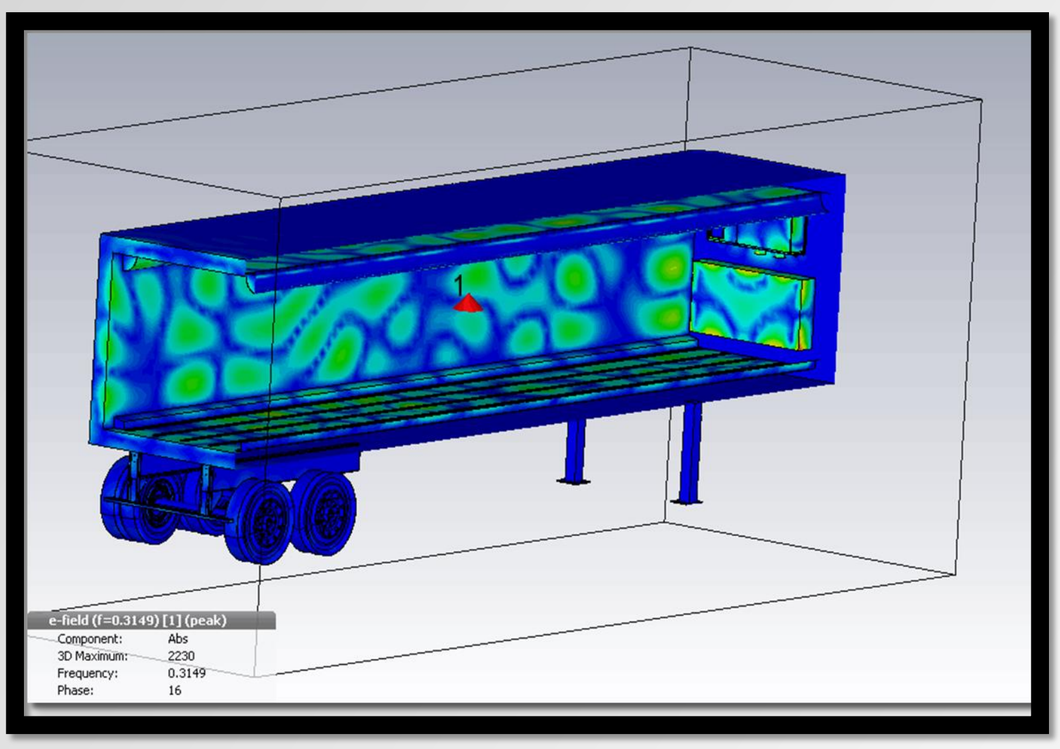
Problem Size

A model of the trailer was imported into CST. Problems on the scale of 10-100 wavelengths are bigger than normal, and this sheer size of this problem was one of the biggest challenges of this project. Simulation options and meshing options had to be carefully chosen. A typical simulation has over 30 million mesh cells and takes over an hour to run using a 16 core, 192 GB RAM workstation. Time this summer was also devoted to enabling GPU computing with this computer to allow for faster simulations.



Electric Field Simulation

The needed simulation result is the strength of the electric field at different points in the trailer. Points of low and high RF field strength are determined by the simulations under a variety of conditions, including source type, source placement, and additional materials inside the trailer. In progress is a test plan for later in the summer where measurements of RF fields will be taken in a similar trailer to verify the accuracy of the simulations.



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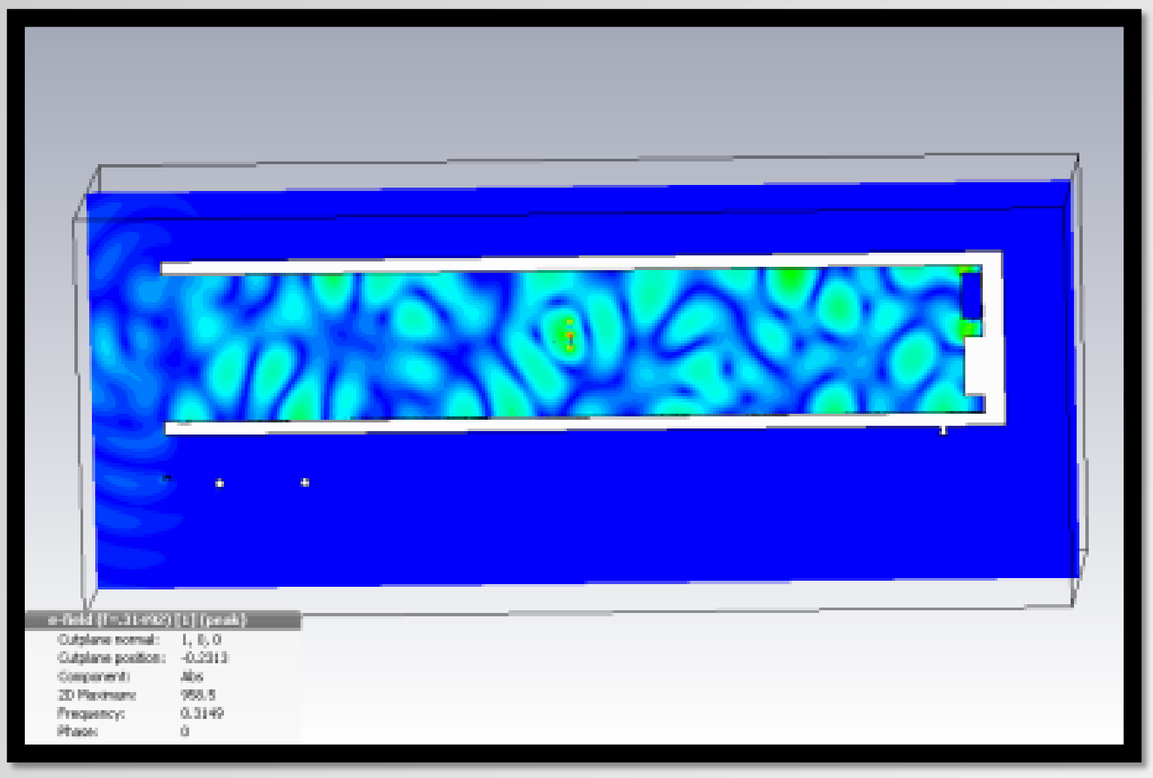
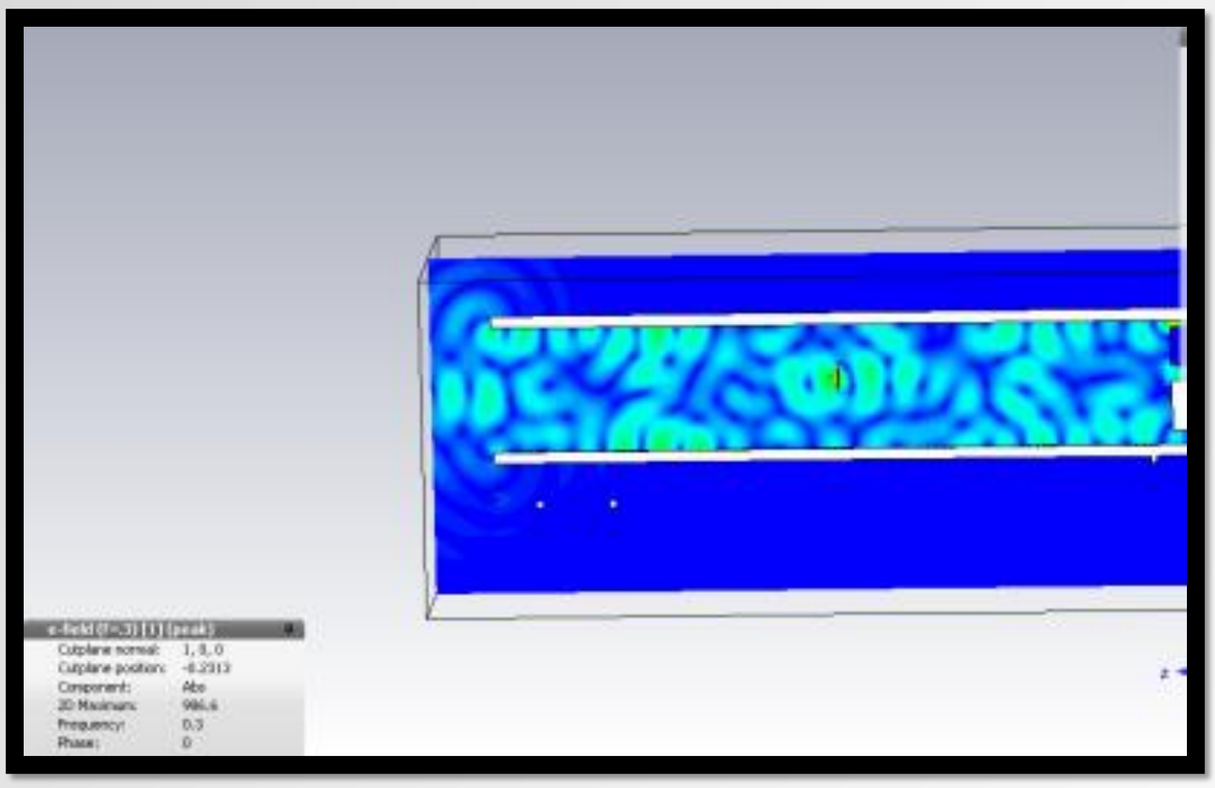
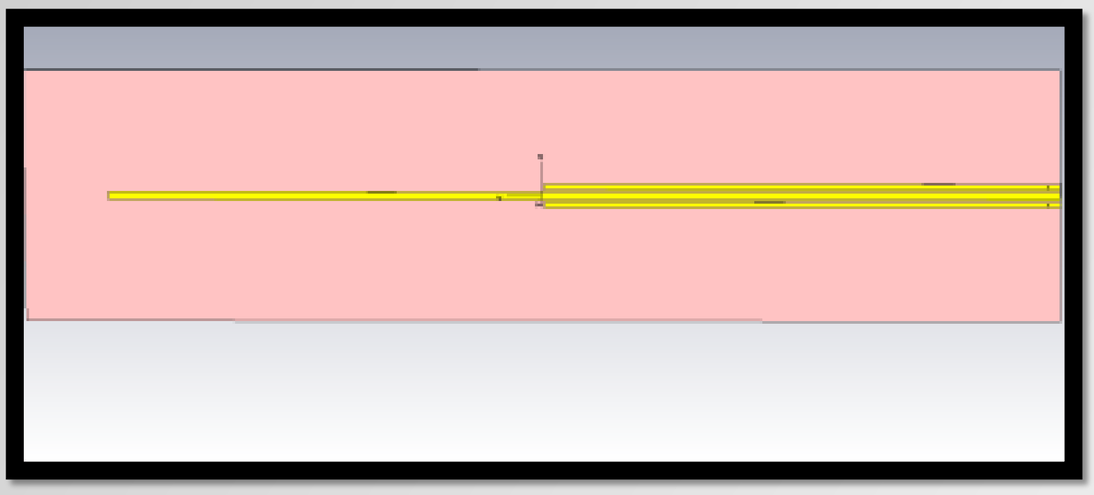
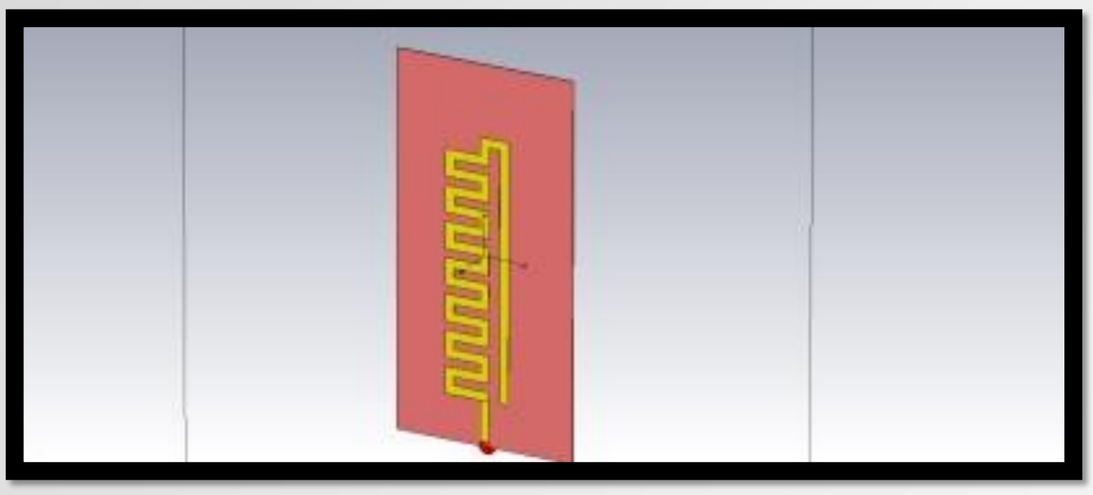
Metal Selection

One deliverable this summer was helping in the selection of the steel material for the test trailer. Research was done into several commercially available steel types to determine their electrical properties. Simulations were done using these different parameters, and it was determined RF field strength in the trailer was mostly independent between the varying steel types.









Antenna Design

As part of the test plan, there must be a transmitting antenna. The plan is to have an antenna printed onto a flexible substrate for conforming to curved areas of the trailer. Since the antennas are designed for the lower UHF band and very thin, low permittivity substrates, special design considerations were needed to make the antennas radiate efficiently and not take up too much space.

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