This research was funded by: Computational Science and Engineering Department

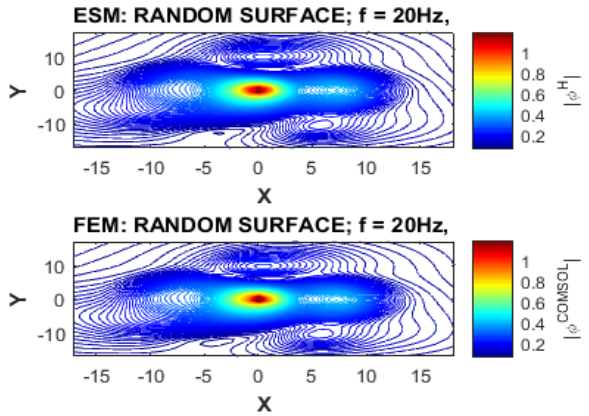
NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY

Daniel T Ocansey

Computational Science & Engineering

Title: *Modeling the Effect of Propagating Acoustic Noise over a Smooth-Random Surface by Using the Equivalent Source Method and the Finite Element Method*

Major Professor: *Dr. Marwan Bikdash*



- Top is the ESM method and bottom is the FEM method.
- The contours of the absolute pressure field matches well.

RESEARCH QUESTIONS / PROBLEMS:

- Noise generated by large explosion at military base cause a lot of discomfort to resident living in the vicinity, for up to 20km away.
- The military produces noise by using gunfire, explosion, artillery fire, and military vehicles such as airplanes, tanks, and personnel carrier vehicles.
- Most structures with a low resonant frequency, such as windows, tables, plates etc. Vibrate as a result of their interaction with low-frequency noise.
- Major roads and bridges are damaged as a result of the low-frequency explosion.

METHODS:

- Model the acoustic field over an smooth-random arbitrary surface with low-frequency harmonic excitation by using the Equivalent Source Method (ESM).
- Compare the performance of the ESM model to the Finite Element Method (FEM) for different form of hard surface: one-hump, two-humps, undulating, and smooth random surface.
- Develop a boundary condition to estimate complex amplitude of the equivalent source below the soft arbitrary surface.
- Compare the performance of the ESM model to the FEM for a smooth random landscape.

RESULTS / FINDINGS:

- The FEM model, is then studied, and its performance is compared with that of the ESM.
- The ESM and the FEM agreed to within 2%, but the memory requirement for the FEM was significantly higher.
- The memory requirements of the FEM grows very fast with the wavenumber.
- The FEM turns to grow cubically (DOF) while the ESM grow quadratically (number of sources).

SIGNIFICANCE / IMPLICATIONS:

- This can be used to estimate the effect of a mono acoustic bomb from residents up to about 20km.
- The low-frequency noise can be mitigated using an undulating or a smooth-random surface.
- The time and memory needed to compute the pressure field is significantly small compared to the FEM.