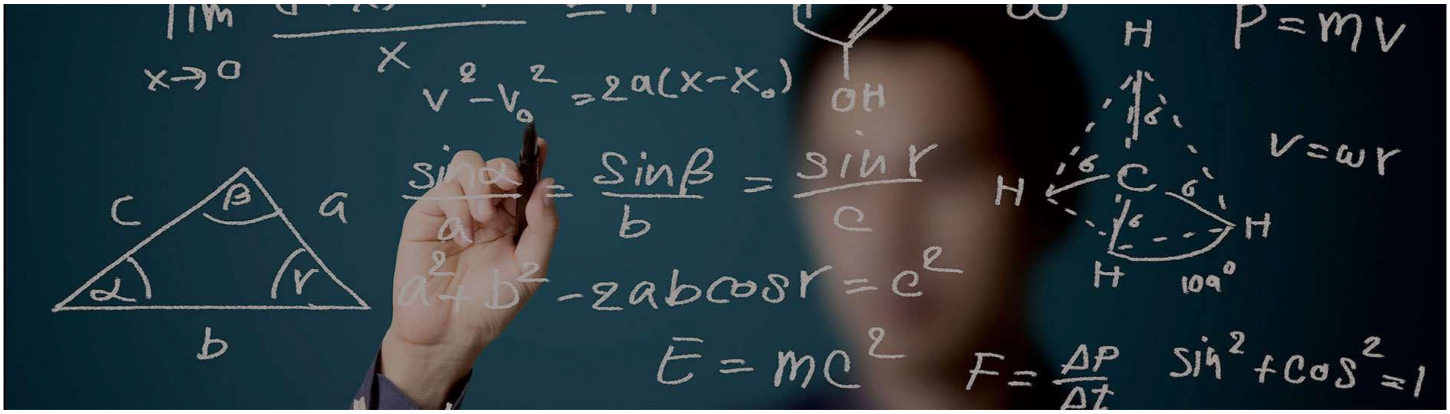


SPRING 2024

RENSSELAER POLYTECHNIC INSTITUTE

DEPARTMENT OF MATHEMATICAL SCIENCES COLLOQUIUM

CENTER FOR MODELING, OPTIMIZATION AND COMPUTATIONAL ANALYSIS (MOCA) SEMINAR

Vianey Villamizar (Brigham Young University)

March 14, 2024 - 4pm

Location: PITTS 5114

Numerical Methods for Sound Waves and Absorbing Boundary Conditions

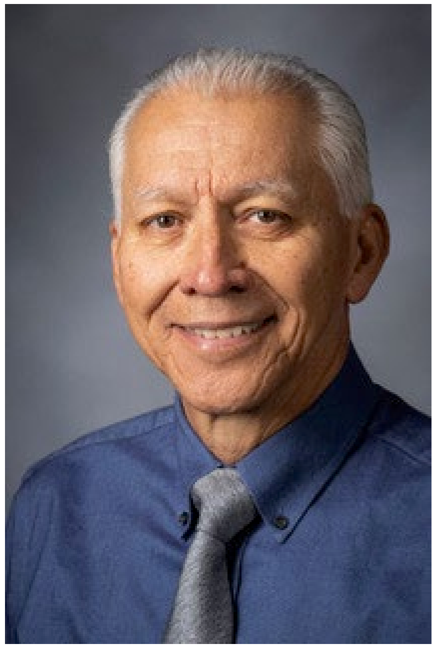
Equations modeling wave phenomena in fields such as geophysics, oceanography, and acoustics among others, are normally defined on unbounded domains. Due to the complexity of the corresponding boundary value problems (BVP), in general, an explicit analytical technique cannot be found. Therefore, they are treated by numerical methods. Major challenges appear when numerically solving wave problems defined in these unbounded regions using volume discretization methods. One of them consists of the appropriate definition of absorbing boundary conditions (ABC) on artificial boundaries such that the solution of the new bounded problem approximates to a reasonable degree the solution of the original unbounded problem in their common domain. That is why the definition of ABCs for wave propagation problems in unbounded domain plays a key role in computation.

In this talk, I will describe our recent construction of high order local Farfield Expansions absorbing boundary conditions (FEABC) for time-harmonic acoustic scattering in two– and three–dimensions. A computational advantageous aspect of the FEABC is its local character. It means only few boundary points or elements are needed to compute the approximate solution at the different stages of the computation. This constitutes a significant improvement over well-known high order absorbing boundary conditions such as the Dirichlet to Neumann whose global nature requires computation over all the nodes or elements at the artificial boundary. We use this novel ABC to construct overall high order numerical methods for single and multiple scattering problems by coupling finite element and finite differences numerical methods with the FEABC.

Refreshments served at 3:30pm 4th floor Lounge – Amos Eaton

Biographical Sketch

Dr. Vianey Villamizar has been a professor of Mathematics at BYU since 2000. After receiving his BS and MS in Mathematics at Universidad Central de Venezuela, he earned a PhD in Applied Mathematics at Rensselaer Polytechnic Institute under the direction of Dr. Julian D. Cole. Recently, he was awarded a Fulbright U.S. Scholar to do research at the Barcelona Supercomputing Center in Spain. His research areas are Numerical Methods for Wave Phenomena: Acoustic, Electromagnetic, and Elastic Scattering. Elliptic Grid Generation. Singular Perturbation Methods Applied to Linear and Nonlinear Partial Differential and Integral Equations.



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