

Kerrigan Research Minigrant Proposal

Student: Matthew Eller

Professor: Dr. Mahboub Baccouch

Project Start: November 1, 2018, **Project End:** June 30, 2019

Title of Project: Fourier series expansion methods for the heat and wave equations in two and three dimensions on spherical domains

Description: The Fourier series expansion method is an invaluable approach to solving partial differential equations, including the heat and wave equations. For homogeneous heat and wave equations, the solution can readily be found through separation of variables and then expansion of the solution in terms of the eigenfunctions. Solutions to inhomogeneous heat and wave equations through Fourier series expansion methods were not readily available in the literature for two- and three-dimensional cases. In my previous paper, I developed an approach for solving inhomogeneous heat and wave equations on cubic domains using Fourier series expansion methods. I shall extend my general method of solution for the inhomogeneous heat and wave equations in two and three dimensions with associated boundary and initial conditions from rectangular domains to those with spherical symmetry. For the two-dimensional equations, the domains to be considered shall be a circle and annuli. For the three-dimensional equations, the domain to be considered shall be a sphere.

Purpose:

1. Review Fourier series expansion methods on cubic domains
2. Review/ study Bessel functions, Legendre polynomials
3. Extend Fourier series expansion to inhomogeneous 2D and 3D heat and wave equations on a disk, an annuli, a wedge, cylinder, and a sphere
4. Numerical calculation considerations for solutions to equations
5. Present research at the 11th Annual Student Research and Creative Activity Fair (March 1, 2019, Criss Library, UNO)
6. Write the final report
7. Prepare a paper for publication

Timeline:

| Month | Purpose Item |
|--------------------------|--------------|
| November | 1 |
| December | 2 |
| January, February, March | 3, 5 |
| April, May | 4 |
| June | 6 and 7 |