2019 version

Faculty Member: Ryan Jensen   **Faculty ID:** 2029 2992

Department: Mathematics   **Faculty Email:** jensenrj@sfasu.edu

Have you previously received a SURE award? no   **If yes, when?**_____

If yes, how did you disseminate results from previous awards (successfully published a paper or obtained a grant, submitted paper or grant based on results, presented results at external conference, etc.):_____

_____

Student's Name: Logan Willhoite   **Student ID:** 20278034

Major: MATHEMATICS & PHYSICS   **Student Email:** Willhoitlt@jacks.sfasu.edu

Have you previously received a SURE award? No   **If yes, when?**_____

Proposed SURE Project

Title of proposed SURE project: The Homology of the Apollonian Gasket

Description of proposed project (describe the scope of the project, including specific objectives):

Given the nth iteration of an Apollonian Gasket we will produce its corresponding bar code. Since the classical method of filtering by sublevel sets depends on the orientation of the Gasket, we will develope a method that uses a filtration by subradial sets, which does not depend on the orientation.

If we are successful in this, then the next step would be to investigate sphere packing.

Is this a new project or a continuation of a current project? If a continuation, what new work will be done a part of SURE?

This will be a new project.

Project timeline (activity/task and time to complete):

- Literary research - 2 to 3 days as we have already completed most of it
- Latex/Bibtex - During Spring Semester 2019
- Haskell - 1 week to learn new programming language
- Develope algorithm to compute n^{th} level of Apolonian Gasket - $\frac{1}{2}$ week
- Develope algorithm using radii and Descartes Equation to produce a barcode - 4 weeks
- Compiling Results - $\frac{1}{2}$ week

Description of research and professional skills that the student will develop from the project:

- Use of Descartes equation, as well as advanced geometric identities.
- Being able to present any information obtained in a clear description.
- Communication skills when presenting and relaying information with the Collaborating professor
- Better understanding of Circle Packings and the topological aspects that can be studied from them.

Description of the involvement and activities that the student and mentoring faculty will have in this project

- Weekly meetings during Summer 2, around an hour each. These may include lab sessions or computer programming sessions

Potential impact or significance of research:

While this research may not have any known real world applications, Many discoveries of techniques or properties when studying the Apollonian Gasket from a topological view would be new to the Mathematics Community

Research Design (approach/methodology):

- Analyzing different Apollonian Gaskets to Search for some pattern.
- Studying how they are generated as it is a fractal
- Using geometry and manipulating Descartes equation
- Observing different steps of the fractal in the hope that we could make approximation as the number of steps tends to infinity

Literature review for project (must provide at least five peer-reviewed sources):

- Computational Topology   Herbert Edelsbrunner and John L. Harer.
- A Tale of Two Fractals   Aleksandr Aleksandrovich Kirillov
- "Apollonian Circle Packings" in Fractal Geometry and Stochastics   Mark Pollicot
- Introduction to Circle Packing   Kenneth Stephenson
- "Computing Science: A Tisket, a Tasket, an Apollonian Gasket"   Dana Mackenzie

Description of how you will disseminate results from the project:

Given an oral Presentation of results at the MAA Sectional meetings Fall 2019

Budget ($0-$500 with justification):

Amount requested for supplies from SURE: $_____

Amount requested for supplies from department: $_____

Amount department will fund faculty stipend: $_____

Amount department will fund student stipend: $ 500 - _____

Chair approval: _____
Chair Signature

I have reviewed and agree to fulfill the expectations of the SURE award.

_____
Student Signature

_____
Faculty Signature

For internal purposes only:
Proposal Awarded _____   Proposal not award_____   Amount awarded: _____
Accounts to be used for award:_____

Note: This proposal was fully developed by the student. The professor is very interested in continuing to work w/ the student. They have an existing research relationship.

AB