

# Project Proposal

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## Introduction

Rayleigh-Taylor instability (RTI) forms at the surface of contact between two fluids, one of which is denser and accelerates toward the other. Formations in RTI are not symmetric between the denser and lighter fluids, and the features of both sides serve to characterize the RTI. However, these features quickly rise in complexity, and it is unrealistic to simulate them beyond a given time threshold. In our project we hope to provide insights regarding structure that apply to RTI generally, including in the later stages of RTI development, using TDA methods.

## Project Objective

In this project, we plan to explore various topological filtrations of RTI data to determine

## Data

We will collect our data via simulation.

Background

Technical Contributions

Expected Outcomes and Deliverables

Evaluation

Proposed Methods

Software

Timelines

Since we are attempting to reproduce the results of the paper, as well as do our own parametric analysis, we will closely follow their TDA pipeline. Our rough project timeline is as follows:

*Week 1:* Analyze the paper carefully and create software to generate a data-set for each time-step.

*Week 2:* Learn how to extract isosurfaces at each time-step.

*Week 3:* Extract and store a combinatorial Morse-Smale complex for each time-step.

*Week 4:* Learn how to extract relevant homological information from the filtration necessary for the final step.

*Week 5:* Construct merge-trees to display results.

*Week 6:* Play around with parameters, prepare for project presentation, and begin work on final report.

Project Summary