**Abstract:**

This report outlines the ongoing research project focused on analyzing the stability of blood flow in arteries. The study simulates and understands the complexities of pulsatile flow, crucial for deciphering various physiological and pathological conditions. Initial efforts have involved developing a Python-based simulation of the pulsatile flow equation, drawing upon foundational work in fluid mechanics and recent advances in resolvent analysis. The subsequent phase aims to incorporate resolvent analysis techniques, adapted from the work of McKeon and Sharma, to further dissect flow stability and transitions in arterial systems. This report presents our progress, interim findings, and outlines the next steps in our investigation.

**Introduction:**

Blood flow within arteries presents a critical area of study in biomedical engineering and fluid mechanics, given its implications for human health and disease. The pulsatile nature of blood flow, driven by the heart's cyclic pumping, introduces unique challenges in predicting flow stability and understanding the onset of turbulence. Recent advancements in resolvent analysis offer new avenues to explore these phenomena with greater depth. Our project seeks to merge classical approaches with these novel analytical techniques to provide comprehensive insights into arterial blood flow dynamics.

**Problem definition:**

The primary objective of this project is to analyze and predict the stability of blood flow in arteries under various conditions resulting in laminar flow to turbulent flow. Blood flow in arteries is inherently pulsatile, exhibiting complex patterns that are influenced by multiple factors including arterial geometry, flow rate, and heart rhythm. Understanding these dynamics is crucial for diagnosing and treating cardiovascular diseases. The project aims to develop a computational framework capable of simulating these conditions and analyzing the flow's stability and transitions towards turbulence.

**Progress Made:**

**Pulsatile Flow Equation Simulation**: We have successfully developed a Python code that simulates pulsatile flow based on the equations outlined in the provided Wikipedia reference. This initial model serves as the foundation for our analysis, enabling us to simulate the basic dynamics of blood flow in arteries.

A screenshot of a math problem

Description automatically generated

The python code is as follows.

The results we got are close to what we can see on Wikipedia.