**Spring 2021: ME759 Final Project Proposal**

**Project Title**: Systems of conservation law solver

**Link to git repo for project**: https://euler.wacc.wisc.edu/kangqi/me759-kangqi/-/tree/master/FinalProject

**Problem statement**: explain in clear terms what you plan to accomplish.

In this final project, I am going to implement a finite volume solver for shallow water equations, which is a very classical system of hyperbolic equations, in other words, conservation laws. This solver will have several finite volume schemes including first order upwind, second order Lax-Wendroff, third and fifth order WENO method. I will first implement the serial solver and then choose to implement either MPI or OpenMP parallel version solver. If time is permitted, I will try to implement both of them. After that I will compare and analyze the different numerical scheme as well as the performance of serial and parallel versions for example the strong and weak scaling analysis.

**Motivation/Rationale**: explain why you chose to work on this project.

I took Math 714 – Computational Mathematics last semester. In that class, we learned finite difference and finite volume methods for numerical solutions partial differential equations. I want to use this chance to do more practice via implementing both serial and parallel solvers.

**Explain how you contemplate going about it**: indicate if you’ll use GPU/OpenMP/MPI parallel computing, what libraries, etc. Indicate what algorithms/approaches you are considering.

I will use MPI and/or OpenMP.

**ME759 aspects the proposed work draws on**: bulleted list, be brief

MPI, OpenMP, Benchmark, Strong and weak scale analysis, etc.

**Team member[s]:**  (if more students, list \*alphabetically\* according to last name)

* Name: Kangqi Fu
* Email: kfu9@wisc.edu
* Home department: Math, Physics and Computer Science Department
* Advisor: (if you don’t have an advisor, please state so) undergraduate; don’t have an advisor
* Student’s role in project: Since I am doing individual project, I will do everything for this project.

**Deliverables**: what you expect to deliver on 05/07/2021, 10:05 AM: code, input files, tech report, etc.

I will present both code and tech report which contains the plots. I may also present the plot separately.

**How you will demonstrate what you accomplished**: this is particularly important if what you do is a small piece of a bigger project that you will continue to pursue after wrapping up ME759.

I will have both a serial and either MPI or OpenMP parallelized C++ code and a technical report. The report will contains details of the set up of the numerical scheme and how I set up the parallel scheme. Since this is not a math class, I will only give a brief introduction of the math part analysis for example complexity, order of accuracy, etc. I will spend more time on the parallelization analysis via plots like strong and weak scaling and benchmark analysis.

**Other remarks**: say here anything else that you think Dan should be aware of and doesn’t fall within any other category above.