

WORKING WITH CAFUNWAVE

JONATHAN SAN MIGUEL

STEVEN BRANDT

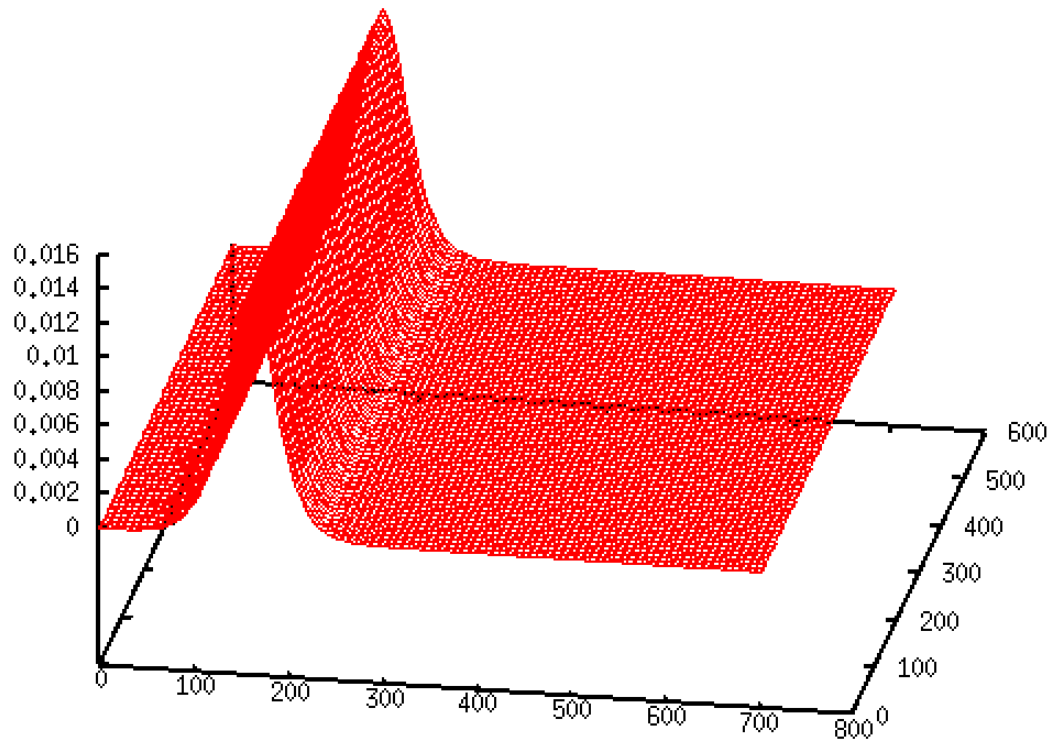
QIN CHEN

WHO AM I?

- Sophomore physics and computer science major at University of Maryland
- Always been interested in computers

WHAT'S CAFUNWAVE?

- CaFunwave is a computational fluid dynamics application for Cactus, a parallel simulation framework.
- Models the Boussinesq Equations, which are 2D approximations of 3D fluids. The lower dimension is critical for efficiency.
- Based on Funwave-TVD, a program by Fengyan Shi at the University of Delaware.



Irregular Wave in Cafunwave

THE PROCESS

- **Step 1: Learning.** I built a 1-dimensional solver in Java using many of the same methods as CaFunwave. I then rebuilt this solver in Cactus to parallelize it.
- **Step 2: Building the Tests.** The goal was to compare CaFunwave to Funwave-TVD on as close terms as possible to check for consistency and unimplemented features.
- **Step 3: Debugging.** I ran the tests, and fixed any problems I could find.

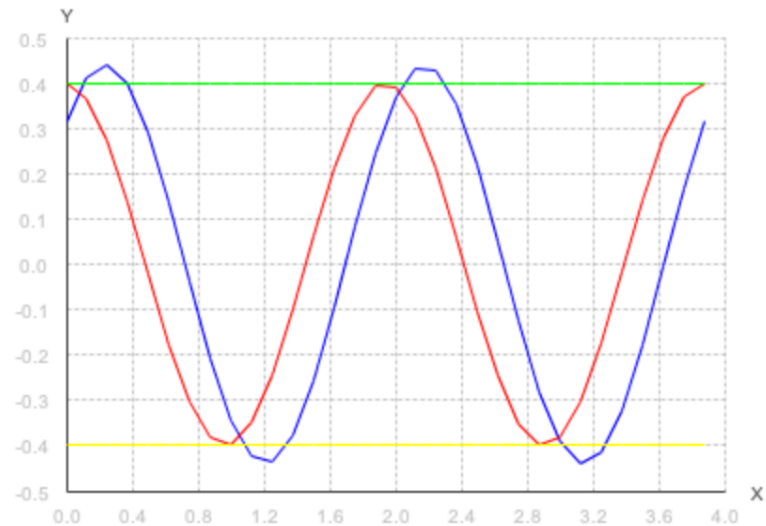
JAVA SOLVER

Features

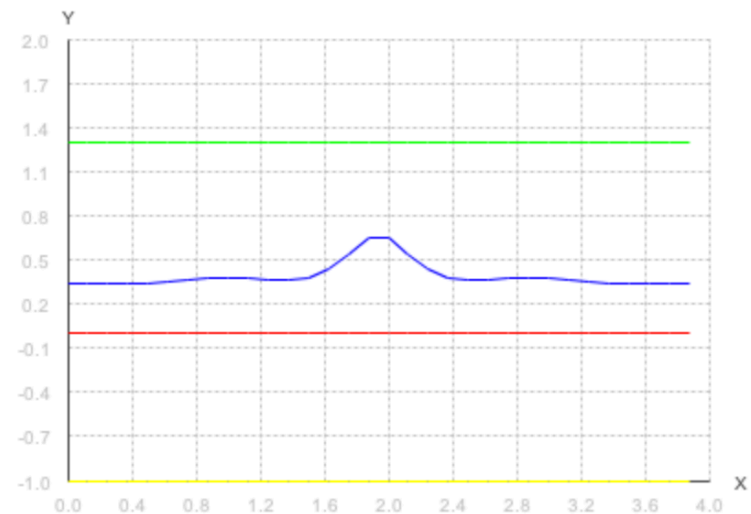
- Able to solve any 1-dimensional partial differential equation
- Calculates error using known solutions

Challenges

- Making the program flexible enough to work with different equations
- Visualizing the data in real time.



Wave Equation



Shallow Water Equation

TEST HARNESS

What it does

- “Translates” Funwave-TVD input files to Cactus parameter files
- Uses Funwave-TVD as a benchmark; it has a more complete feature-set and has been tested more extensively
- Can compare with actual experimental data

Challenges

- Learning new languages (Perl, regex)
- Working with the hundreds of parameters required by each program, as well as the large data-sets

IMPACTS OF RESEARCH

For Me

- My first large-scale computer project, and first research project
- Experience with high-performance computing

For Science

- CaFunwave has applications for coastal modeling, which is important in Louisiana
- Test harness can be reused in the future