Welcome and outline

Welcome every one to our presentation.
My name is Bob Vergauwen and this is Ferre Van Asche and we are going to tell you something about the research we did for the course on computational methods for astrophysics.

I'll firs start by giving a short introduction to what we did, after this Ferre will explain some of the methods that we used to solve the hydrodynamical equations.
After this i will take the word again and tell you a bid more on how we did it and what we used to solve the equation.
Next Ferre will explain our first results for the 2d Riemann problem.
To finish the presentation we will look at an other type of problem.

Introduction

Let us first start by explaining what a Riemann problem is.
A Riemann problem consist of solving a typical conservation law with a given piecewise constant initial condition.
These problem will be rarely found in nature but the solution can yield a lot of insights in the behaviour of fluid dynamics. More over, Riemann problems are often used as benchmarks to test the performance of different numerical methods.
For our experiment the initial condition where divided in to four different sections as shown on the slide. We choose 7 different initial conditions all with different values on each of the 4 parts.
In this presentation we will discuss two of these results in greater depth.

The equations

The conservation equations we want to solve our those for an compressible fluid, thes equation are better known as the Euler equations.
As can be seen from the slide, we have 4 conserved quantities, the mass, the momentum in both directions and the local energy. Writing down this equation is the easy part, solving it is a whole lot harder.

Ferres part goes here

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Of course did we not implement all these methods are selfs. We used the provided software amrvac for doing this. This is an open source software tool that is developed at the kuleuven. But probably is every body familiar with this software so we are not going to go deeper in this.

To get accurate predictions of the schemes it was necessary to use a fine enough grid to perform our calculations. This in terms resulted in a large computational task. To get results in a reasonable time we got to use the High performance computer located somewhere in flanders.

The interface of this computer was not a usual graphical interface but had to be done over ssh. This was a little bit inconvenient to use so we decided to do something about this interfacing problem.

Interfacing

To make life easier we wanted to be able to change all the files locally and do as little as possible over an ssh connection.
To achieve this goal we wrote a script that did this for us.
The idea was to setup all the necessary files to start the compilation of the
When we ran the script it would than take all those files, move them to the correct location on the server,
compile the code, create a job for it and submit this job to the cluster.
This process could all be run in parallel so that we where able to submit all 5 jobs (each with an other solver) in under 2 min.
After the jobs where finished running (and off course we had a script running to check for that as well) we could run the same script as before
but with an other parameter to get all the data at the same time, it compressed it automatically and dowloaded it to our computer.
This approach worked really well for us, to check each of the different initial conditions we just had to change one file on our own computer
and run the one script again.
Without the calculation time included we where able to setup a new initial condition and return the data in less than 10 minutes
(Of course we had to wait longer till the calculations where finished.)
A last thing we tried was to run the code on the local network of the computer science building.
On this network all of the necessary software to run amrvac was available.
It turned out this was possible but only for a small amount of computers and for a short time.
We think the network was not stable enough to support the amrvac software.
although the firewall of the computer science labs could block it as well.

Some problems

However it did not go that good all of the time, we encountered some problems as well. In the first days of the project we had an annoying bug with the optimisation levels of the compiler. This resulted in a segmentation error.
We solved it by re compiling the one file that crashed again with a non optimised compiler.

An other problem was that some of our files could only be run on one node simultaneous, this of course reduced the super part form the concept of a super computer. We did not manage to find the cause of this problem.

A last thing i would like to tell is the problems we had with the visualisation software paraview, this software kept crashing for now good reason and it took us ages to figure everything out.

Now i would like to give the word to Ferre again to explain some of our findings for the Riemann problem.

Explosion

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