Regression Testing for CHIMERA

Jessica Travierso
Austin Peay State University

Research Alliance in Math and Science
National Center for Computational Sciences, Oak Ridge National Laboratory
Mentor: Dr. Bronson Messer

https://info.ornl.gov/sites/rams09/j_travierso/Pages/default.aspx

Abstract

Understanding the mechanism behind core-collapse supernovae is a main focus of the computational astrophysics group at Oak Ridge National Laboratory. Supernovae are so complex that they cannot be described analytically and must be investigated using numerical methods. CHIMERA is a code developed to produce two and three dimensional, multiphysics simulations of core-collapse supernovae. The purpose of this project is the development of a regression testing framework for CHIMERA. An existing regression testing framework, called FlashTest, is being evaluated for a possible starting point. Regression testing frameworks are useful to code developers because codes need to be tested each time they are modified in order to ensure the modifications do not cause the code to fail.

Purpose

- Evaluate FlashTest regression test software
- Develop regression testing framework for CHIMERA
- Allow code developers to modify code

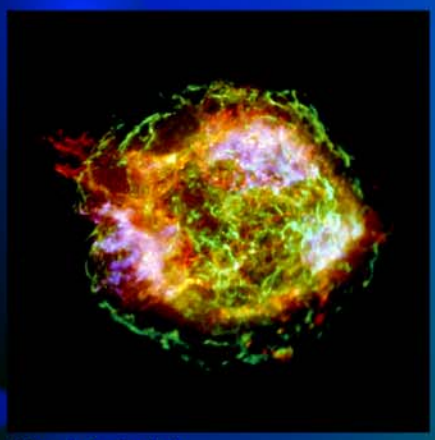

Figure 1. Cassiopeia A.

Core-collapse Supernovae

- Progenitor star has mass greater than eight solar masses
- Final state consists of layered structure surrounding dense iron group core
- Iron group accumulates in massive core
- Iron-core collapses when mass reaches Chandrasekhar limit
- Core bounces due to degeneracy pressure of neutrons, sending shockwave
- Energy lost to neutrinos and degenerate material
- Neutrino heating revives shock

CHIMERA*

- Designed to study core-collapse supernovae
- Written in Fortran 90
- Comprised of three parts:
  - Hydrodynamics module
  - Nuclear burning module
  - Neutrino transport solver within an operator-split approach
- Produces two and three dimensional simulations

*Conservative Hydrodynamics Including Multi-Energy RAdiation

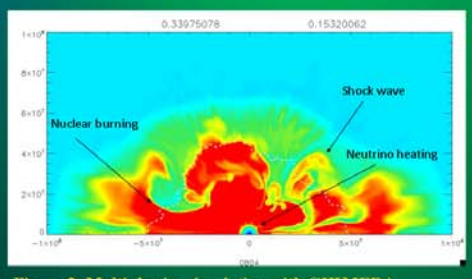

Figure 2. Multiphysics simulation with CHIMERA.

Regression Testing

- Tests code after modifications
- Reruns tests from existing suites
- Add new tests when bug is found
- Ensures modifications have not caused errors or failures
- Essential for distributed development

FlashTest

- Developed for Flash code to study thermonuclear flashes created by supernova explosions at The University of Chicago
- Runs on Unix/MacOSX
- Requires python 2.3 or higher
- Includes ability to "setup, compile, execute, and test Flash simulations"
- Requirements
  - Copy of Flash
  - Configuration file
  - Execution script
  - Test information file
- Tested FlashTest with Sedov problem

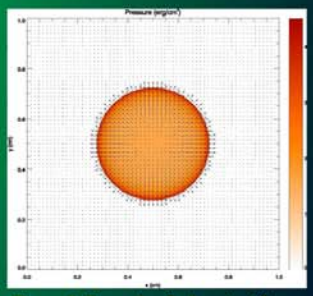

Figure 3. Example xflash output for Sedov problem.

Evaluation

- Developed for Flash 3
- Very limited documentation
  - Setup
  - Running
  - Examining output
- No longer supported

Future Work

- Develop FlashTest for CHIMERA
- Develop effective tests for CHIMERA, not just hydrodynamics tests

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