# PhD Plan

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## 1 Objectives

The objective of my PhD project is to develop the GPR model in various specific ways so that it may be used to simulate the problems of impact-induced detonation of a combustible material in an elasto-plastic confiner. A graphical representation of this problem is shown in figure 1. As can be seen, three states of matter are present (a solid confiner, a liquid combustible confined material, and gaseous surrounding environment). The interfaces between these phases and the exchange of state information between them need to be dealt with in any numerical method employed. The GPR model must also be augmented in some way to capture the kinetics of the chemical reactions present. Up until now, ADER-WENO methods have been used to solve the GPR model. Whilst these are able to provide arbirarily-high-order accuracy solutions in both space and time, they are too slow for the practical applications that we envisage in our lab, even at second-order accuracy; faster numerical solvers are needed.

Thus, there are three main issues that I am addressing in my work:

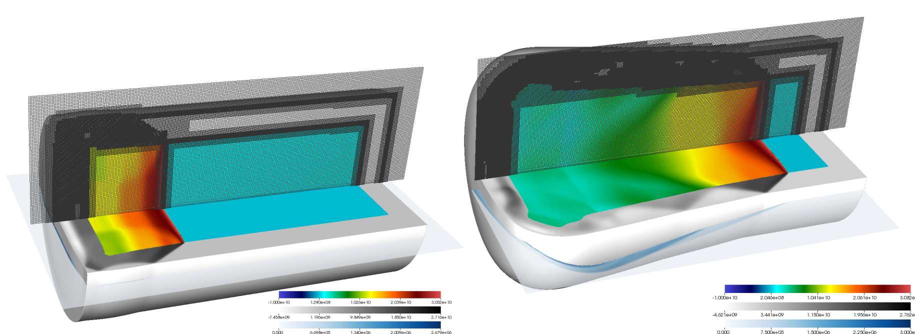

Figure 1: Impact-induced detonation of a combustible material in an elasto-plastic confiner (at two different points in time). Test taken from [**?**].

1. To develop stable and accurate techniques to deal with the interfaces between different materials in multimaterial / multiphase problems
2. To combine the GPR model with the models we use to describe the reactions of a combustible materials
3. To develop numerical methods for solving the GPR model in a reasonable amount of time

## 2 Work Completed

Addressing the three main issues listed above, I have:

1. Developed a Riemann Ghost Fluid Method for the GPR model to deal with material interfaces (paper to come soon). I'm working on a new high-order locally implicit method for enforcing the boundary conditions and calculating the movement of the interfaces.
2. Combined the GPR model with a simple model of arrhenius reaction kinetics.
3. Developed a second-order numerical method for solving the GPR model that is significantly faster than existing ADER-WENO methods. I'm also working on a new solver based on an eigendecomposition of the system (paper to come soon).

## 3 Collaboration with Peshkov et al

The idea we have been discussing for collaboration fits into objective 3. Right now, I do not envisage objective 2 as taking up much time. The new method mentioned relating to objective 1 will take a lot of time to make multidimensional but I think I will be able to work on this concurrently. I think the collaborative work has the potential to produce something that will be very useful in addressing objective 3 and is definitely worth persuing.