DDT simulation using Amazon Web Services

Krzysztof Kunca

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Abstract

This simulation is an analysis of deflagration to detonation transition. To simulate the combustion process OpenFoam has been used.

1 Introduction

In this case, flame acceleration in hydrogen-air mixture and the transition to detonation in a 2D channel is computed. To make a simulation ddtFoam solver hab been used, which is available for OpenFoam 2.1.1. [FE13] All computing was made using Amazon Web Services (8 processors, Ireland).

2 Details

2.1 Solver description

ddtFoam is an OpenFOAM solver developed to simulate the deflagration-to-detonation transition. Computationally efficient as both deflagration and detonation are described using a reaction progress variable. The source code can be downloaded freely from http://sourceforge.net/projects/ddtfoam/.

2.2 Case

The rectangular channel is equipped with some obstacles to promote flame acceleration. The initial hydrogen distribution varies in vertical direction. The initial flow velocity is zero everywhere. The flow is ignited by a small patch where the reaction progress variable c = 1 which represents the ignition kernel. Mesh has been created by editing "meshdefine.c" tutorial file and received cell size is 5mm x 5mm.

3 Results

Detonation appeared at 0.00305-0.0031 s. It is recognized by occurring the pressure wave and the temperature wave at the same place (after 8th obstacle).

Figure 1: Case geometry

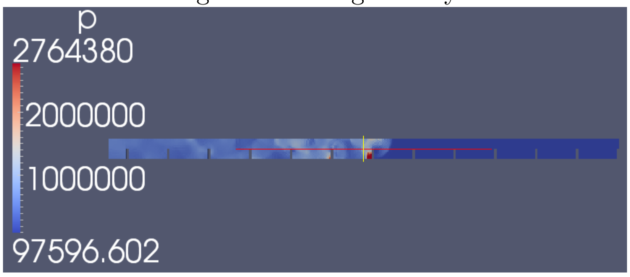

Figure 2: pressure at 0.00295 s

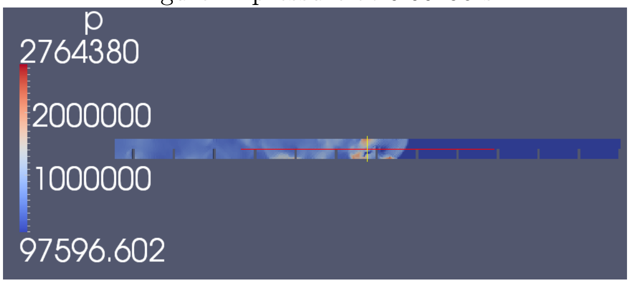

Figure 3: pressure at 0.003 s

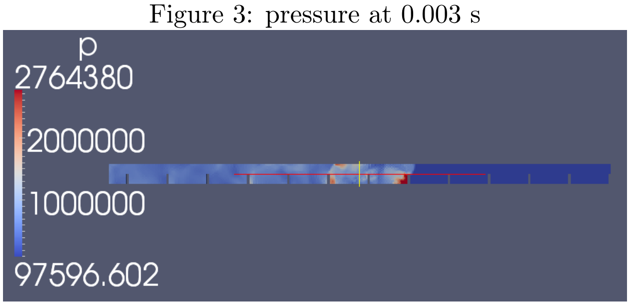

Figure 4: pressure at 0.00305 s

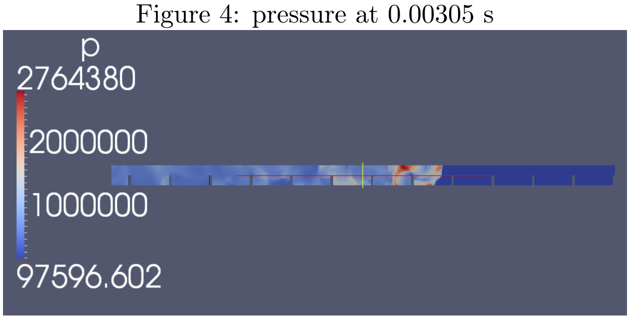

Figure 5: pressure at 0.0031 s

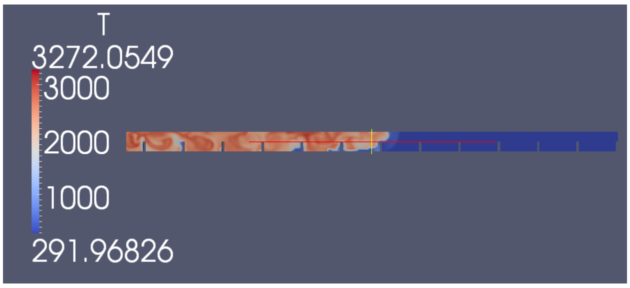

Figure 6: temperature at 0.00295 s

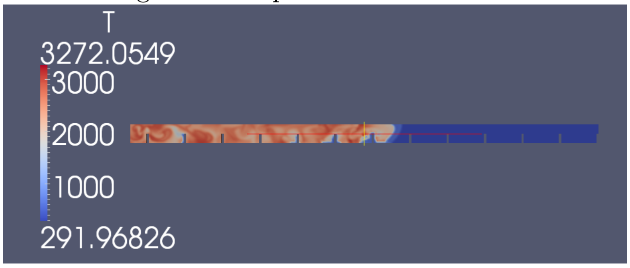

Figure 7: temperature at 0.003 s

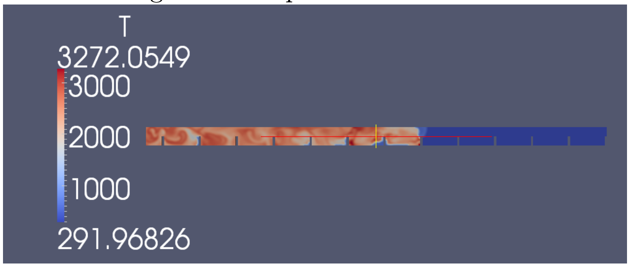

Figure 8: temperature at 0.00305 s

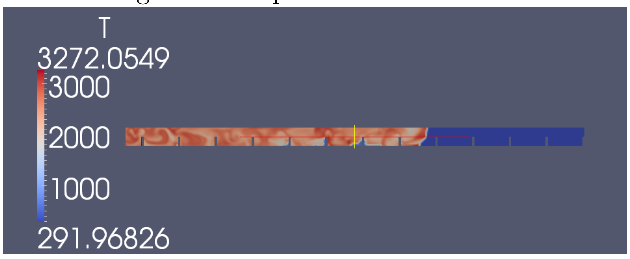

Figure 9: temperature at 0.0031 s

References

[FE13] T. Sattelmayer F. Ettner. ddtfoam. *Lehrstuhl fur Thermodynamik, Technische Universitat Munchen*, 2013.