

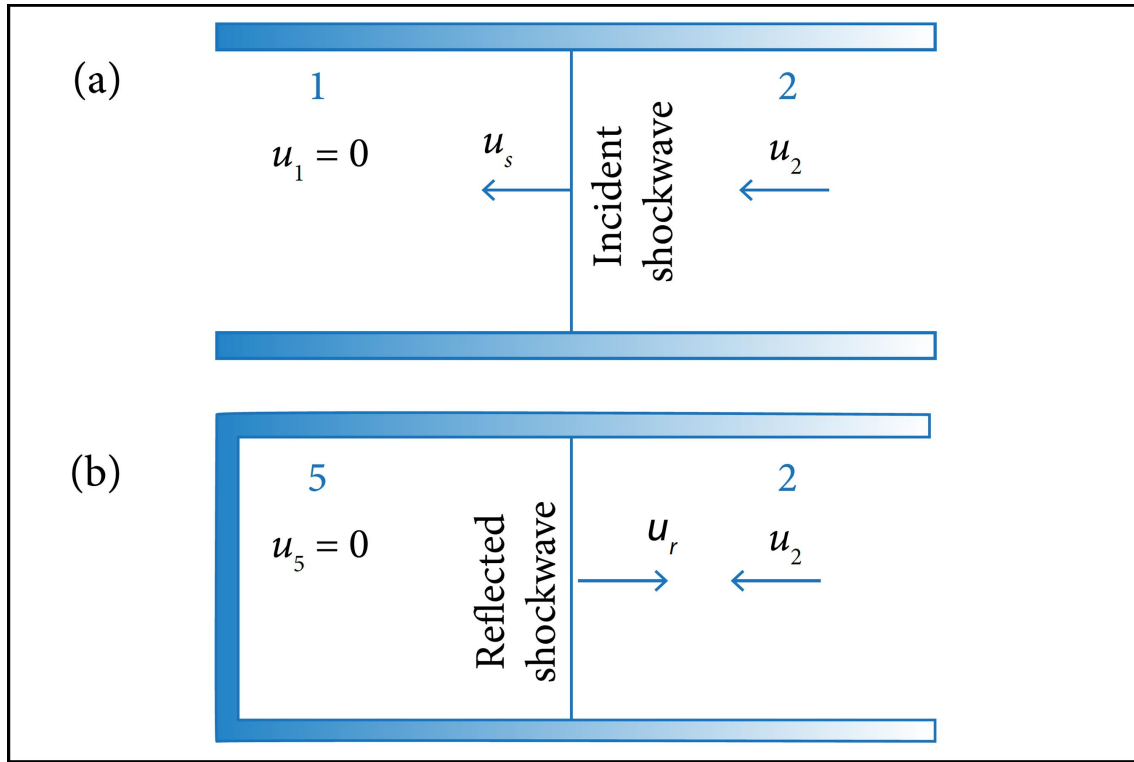
Reflected shock wave. Gas mechanism comparison.

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1 Introduction

The idea of this project was to create numerical model of reflected shock wave of hydrogen and oxygen using SDToolbox library and compare the results achieved by using GRI30 and GRI30highT.



2 Literature

In order to create this project I gathered information mainly from SDToolbox tutorials which are available on SDToolbox website. I also used wikipedia pages to get basic view on the physical process of reflected shock wave.

3 Model characterization

In my code I used GRI-Mech 3.0 mechanism. GRI-Mech 3.0 is a widely-used reaction mechanism for natural gas combustion. It contains 53 species composed of the elements H, C, O, N, and/or Ar, and 325 reactions, most of which are reversible. GRI-Mech 3.0, like most combustion mechanisms, is designed for use at pressures where the ideal gas law holds.

3.1 Starting parameters

My program gives the user possibility to set the starting temperature, pressure, shock wave speed and gas composition by himself as well as the choice of GRI30 and GRI30highT model.

3.2 Program function

After the starting parameters are set, program prints:

1. Frozen post-incident-shock state
 - (a) Temperature
 - (b) Pressure
2. Frozen post-reflected-shock state
 - (a) Temperature
 - (b) Pressure
3. Reflected wave speed

4 Results

As an example I would like to present the results of reflected shock wave with starting parameters:

1. Temperature 300 K
2. Pressure 100000 Pa
3. Wave speed 2000 m/s
4. Mechanism: GRI30highT
5. Gas composition: H2:2 O2:1

Frozen Post-Incident-Shock State (2000.00 m/s) T2 = 1049.47 K P2 = 15.86 atm
Frozen Post-Reflected-Shock State T3 = 4932.90 K P3 = 474.22 atm
Reflected Wave Speed = 784.53 m/s

4.1 Comparison with GRI30

With the same starting parameters but different mechanism:

Frozen Post-Incident-Shock State (2000.00 m/s) T2 = 1049.47 K P2 = 15.86 atm
Frozen Post-Reflected-Shock State T3 = 4912.34 K P3 = 473.91 atm
Reflected Wave Speed = 781.25 m/s

5 Conclusion

Differences between the results when using GRI30 and GRI30highT are subtle in frozen post-incident-shock state, when the temperature and pressure are relatively low. However when we compare the results of post reflected shock state the differences are bigger. This proves the fact that we should use GRI30highT in calculations where we expect the temperature and pressure to be high in order to achieve better results.