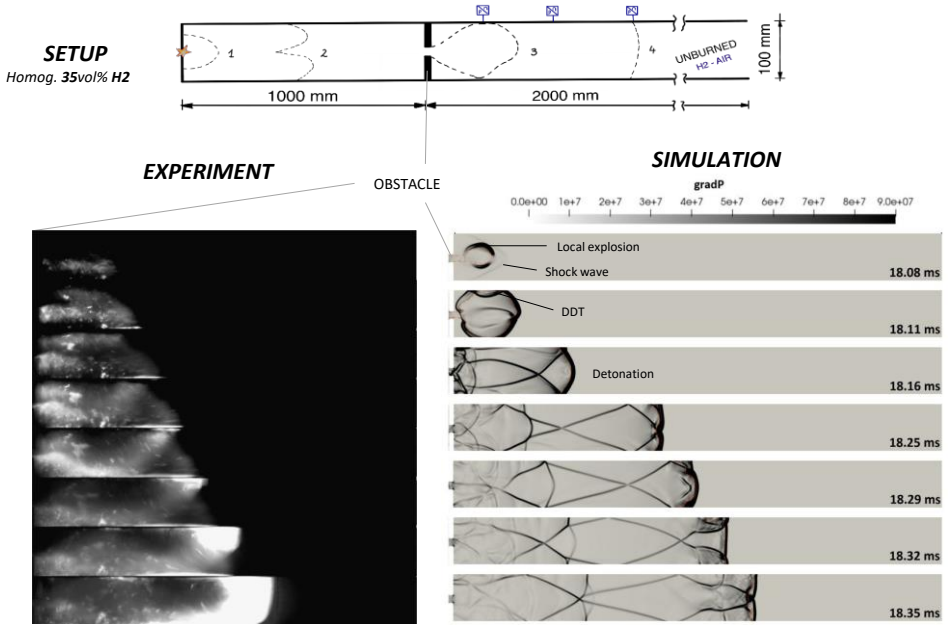
Development of a CFD methodology to mitigate the hazards of hydrogen and ammonia systems

Introduction

Using hydrogen and ammonia as energy sources in the maritime and industrial sectors could lower global CO2 emissions. Accidental explosions are one of the main risks associated with using hydrogen systems and can result in significant financial losses, harm, or even death. Therefore, it is crucial to understand the physics of these explosions to implement safety measures. Large-scale tests are costly in terms of time, money, and resources. Thus, in performing safety assessments, Computational Fluid Dynamics (CFD) can be used as a tool for calculating the consequence of gas explosions.

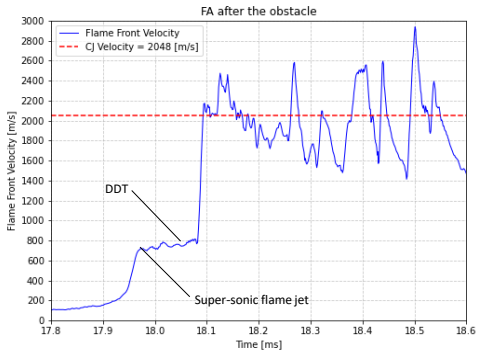
Objectives and Methods

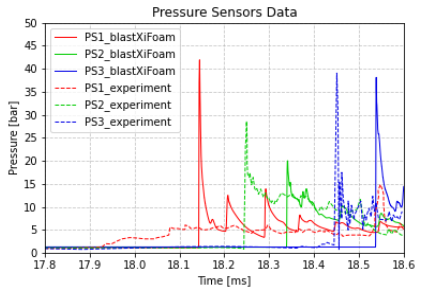
- Theoretical calculations and simulations of the ***physics and dynamics of hydrogen gas explosions*** with open-source tools such as ***Cantera*** and ***OpenFOAM***
- Modification of existing **combustion solvers**
- Creating an improved CFD solver to predict ***flame propagation*** *and* ***transition to detonation*** *in gas explosions*



A. V. Gaathaug, K. Vågsæther, and D. Bjerketvedt, 'Experimental and numerical investigation of DDT in hydrogen–Air behind a single obstacle', *Int. J. Hydrog. Energy* (2012)

Bosnic P., Henriksen M., Vaagsaether K. Flame acceleration and DDT of homogeneous premixed hydrogen-air mixture in obstructed channel: A numerical study using OpenFOAM. European PhD Hydrogen Conference 2024.





Petar Bosnic

Affiliation: **University of South-Eastern Norway** (USN)

Related projects: **FME HYDROGENi**

Supervisor: **Knut Vågsæther** (USN), *Co-supervisor:* **Mathias Henriksen** (USN)

Mechanical Engineer with a Master's degree from the University of Split (FESB) and currently pursuing a ***Ph.D.*** in ***hydrogen safety*** at the ***University of South-Eastern Norway*** (USN). My research focuses on the ***physics and dynamics of hydrogen gas explosions***, employing both ***numerical*** and ***experimental*** analysis to enhance the safety of hydrogen/ammonia systems. With expertise in computational engineering, simulations, and testing, I specialize in the ***development*** and implementation of ***consequence analysis tools*** for safety measures.

Estimated progress of the PhD project:

Just started ...	< 50 %	> 50 %	Almost done ☺

Publications

- Bosnic P., Henriksen M., Vaagsaether K. Flame acceleration and DDT of homogeneous premixed hydrogen-air mixture in obstructed channel: A numerical study using OpenFOAM. European PhD Hydrogen Conference 2024.
- Penga Z., Tolj I., Bosnic P. et al. Combined numerical and experimental analysis of liquid water distribution inside PEMFC flow fields. World Hydrogen Energy Conference 2022.

Norwegian Research School on Hydrogen and Hydrogen-Based Fuels

Norwegian Centre for Environmentfriendly Energy Research

HYDROGENi

SINTEF

IFE

Universitetet i Sørøst-Norge