

SIMULATION SOFTWARE FOR PULSE DETONATION ENGINE

VERTICAL:
AEROSPACE & DEFENCE

SERVICE:
ENGG. SOFTWARE DEVELOPMENT

TECHNOLOGY:
CFD

Our customer is a premier defense establishment with a mandate to explore futuristic technology systems for Indian Forces. One of such system is Pulse Detonation Engine (PDE) that promises to provide thrust at much better efficiencies as compared to any existing engines. PDE uses detonation waves to rapidly compress and combust fuel. Therefore, design of PDE is heavily dependent on movement of waves, which must be simulated for initiating preliminary design.

Zeus Numerix (ZN) carried out a fundamental study of the working of PDE by simulating an idealized PDE. The idealized PDE is a 1-dimensional tube with one closed end and other end open to atmosphere. ZN developed an in-house tool for simulating multiphase Euler equations where reactants and products of combustion are simultaneously present. The combustion was modeled by using single step Arrhenius equation. A combustion cycle is initiated by giving a spark to the fluid at the closed end of the tube. The spark causes an instant detonation and results in a combined flame and shock wave front which travels towards the open end of the tube. This combustion generates tremendous amount of energy and momentum in the fluid which gets ejected from the open end and thus producing engine thrust.

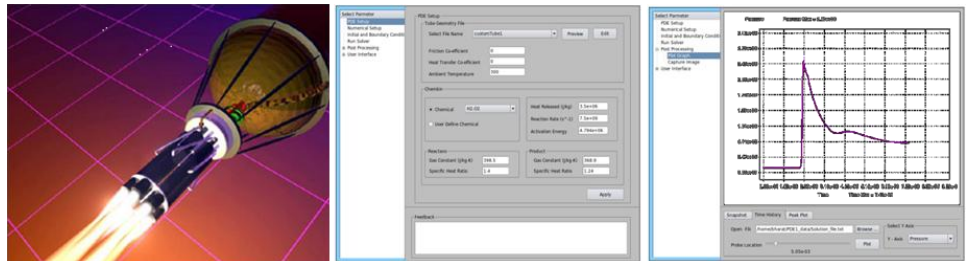


Figure 29: (a) Pulse Detonation Engine (b,c) Snap shots from customized PDE analysis software

The customer was supplied with a GUI driven customized PDE analysis software. A series of parametric analysis was conducted to identify critical design parameters. With this understanding, the customer went ahead with first prototype fabrication.