FORTÉ

Simulating Dual-Fuel Combustion

Dual-fuel combustion has the advantage of providing diesel-like efficiency with gasoline as the primary fuel, providing potential increases in efficiency of 50% while reducing emissions. Typically a small liquid fuel pilot is injected into a lean mixture of air and a more volatile fuel that is less inclined to auto-ignite. Often it is difficult to simulate the separate chemical effects of the two fuels. FORTÉ allows the use of multiple accurate chemistry models to capture fuel effects of both the ignition and flame propagation processes.

FORTÉ accurately tracks flame propagation, which is critical for dual-fuel cases where the injection and auto-ignition of the liquid pilot fuel serves to initiate the flame propagation. In FORTÉ, the simulation can simultaneously consider both auto-ignition and flame-propagation modes of combustion progress. FORTÉ allows investigations of fuel or additive composition effects, impacts on liquid pilot amount and timing, and NO_x reduction techniques such as EGR, etc.

Setting up a Dual-Fuel Engine Case

FORTÉ allows quick set-up of a body-fitted or automatic mesh and the parameters for spray and chemical models that will be used in the simulation. Figure 1 shows an example of diesel micropilot geometry in a sector mesh. The composition can be specified for the premixed port-injected fuel, such as gasoline, as shown in the Gas Mixture panel, Figure 2. A multicomponent vaporization model can be used to match the multi component liquid fuel surrogate model for better coupling between vaporization and combustion.

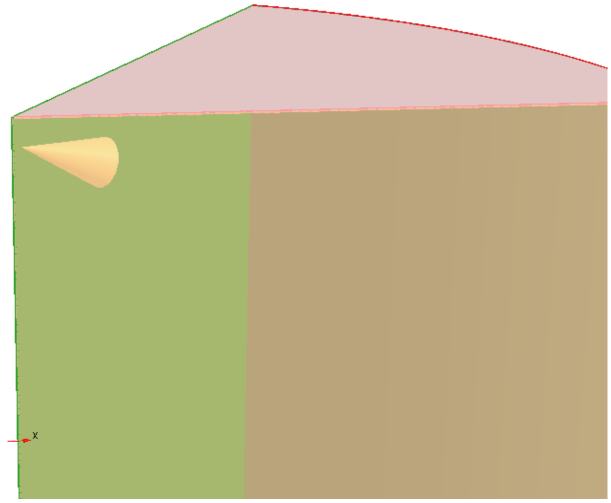

Figure 1. Schematic sector model for the dual-fuel engine, a typical configuration.

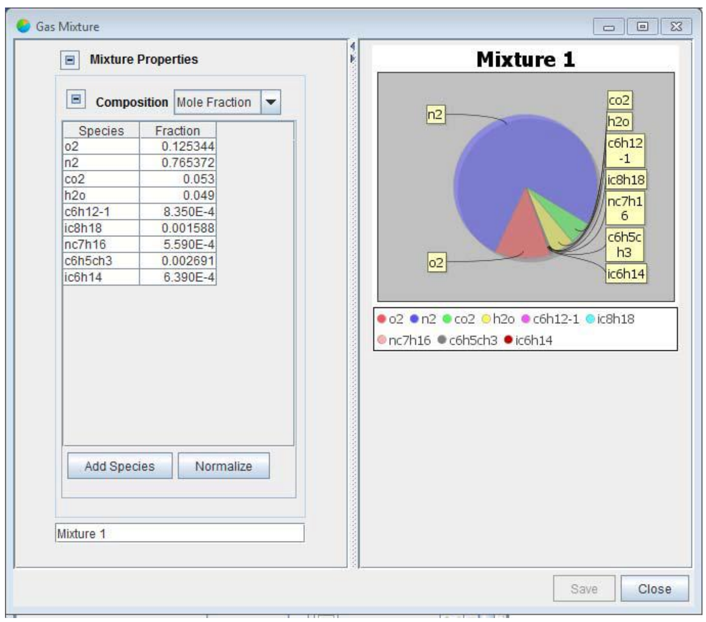

Figure 2. Specify the composition of the premixed fuel.

The FORTÉ auto-ignition mode of initiating flame propagation takes advantage of a good fuel model's ability to accurately predict ignition under auto-ignition conditions of temperature and pressure. In addition, the flame propagation model uses a locally calculated turbulent flame speed that derives from fuel-specific flame-speed calculations using detailed kinetics models. In this way, both auto-ignition and flame-propagation benefit from accurate fuel models for low- and high-temperature kinetics.

Impact of Dual Fuels on Engine Performance

Simulation results are easy to put together with FORTÉ's Visualizer, where wizards are provided for creating line plots, contour plots, cut planes and animations. Basic combustion parameters, such as pressure and heat release, can be plotted, as seen in Figure 3. Contour plots for temperature or other spatially resolved results can be shown on cut-planes, such as the one in Figure 4.

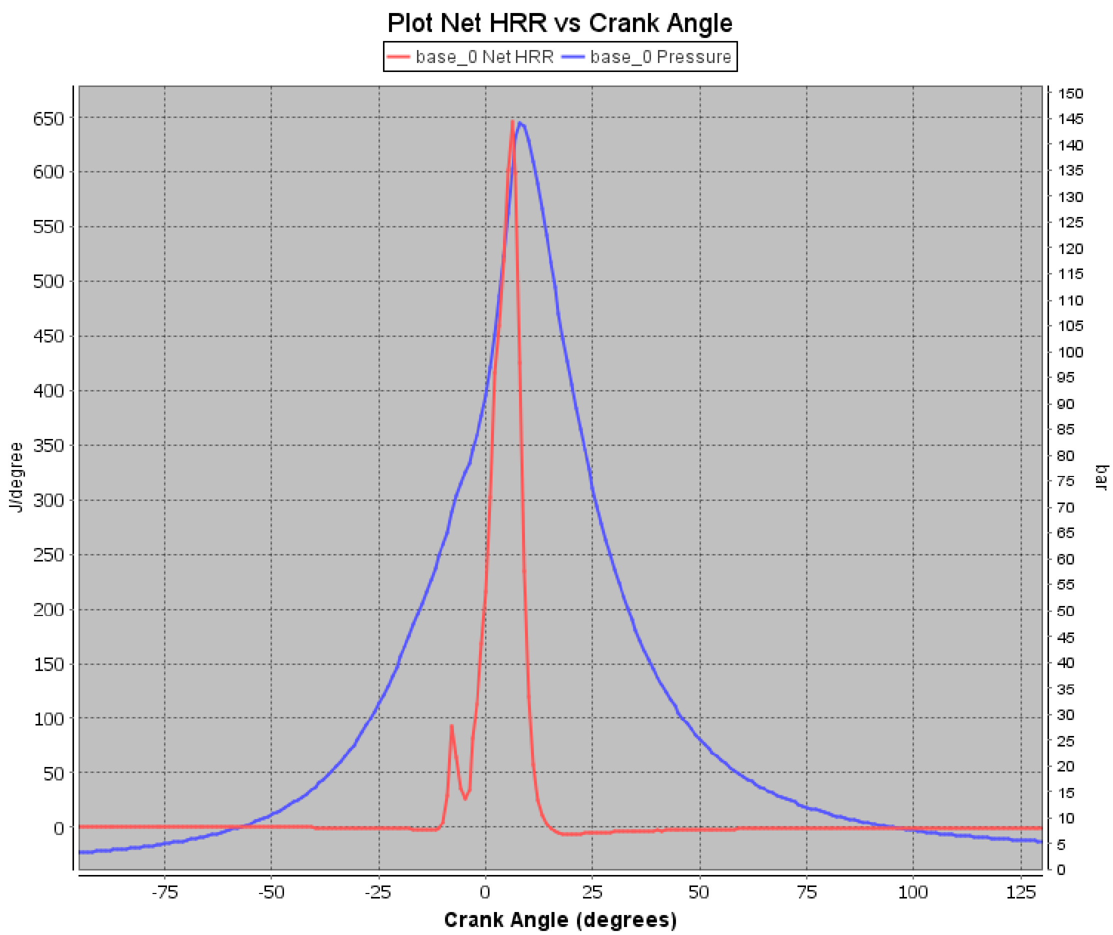

Figure 3. Pressure and heat release from diesel micropilot and gasoline dual fuel case.

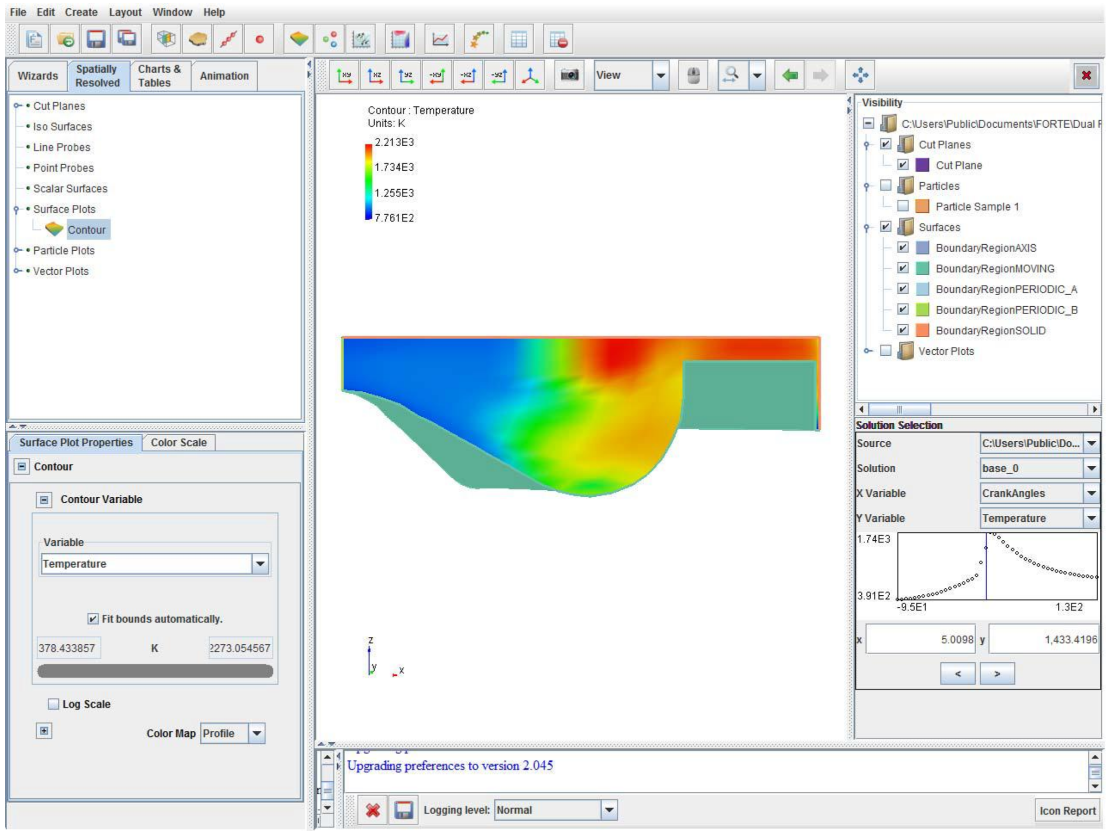

Figure 4. Visualizing ignition and flame propagation in the dual fuels engine.