



Highlights:

Advanced pipe models solving Navier-Stokes

Thermo-hydraulic: always solves energy equation

High-level templates for component design

Choose from 1D to 3D multi-body dynamics

Automated creation of flow model from 3D CAD data

Frequency dependent flow friction

Fundamental cavitation model

Transient aeration model

Transport and track vapor and gases

Pipe wall compliance

Gerotor, gear, vane and other pumps

Fuel Injection and Hydraulics

Fundamentally Based Thermo-hydraulic Simulation

GT-SUITE can be used to design, analyze, and optimize all variants of fuel injection and hydraulic components and systems. Typical applications include:

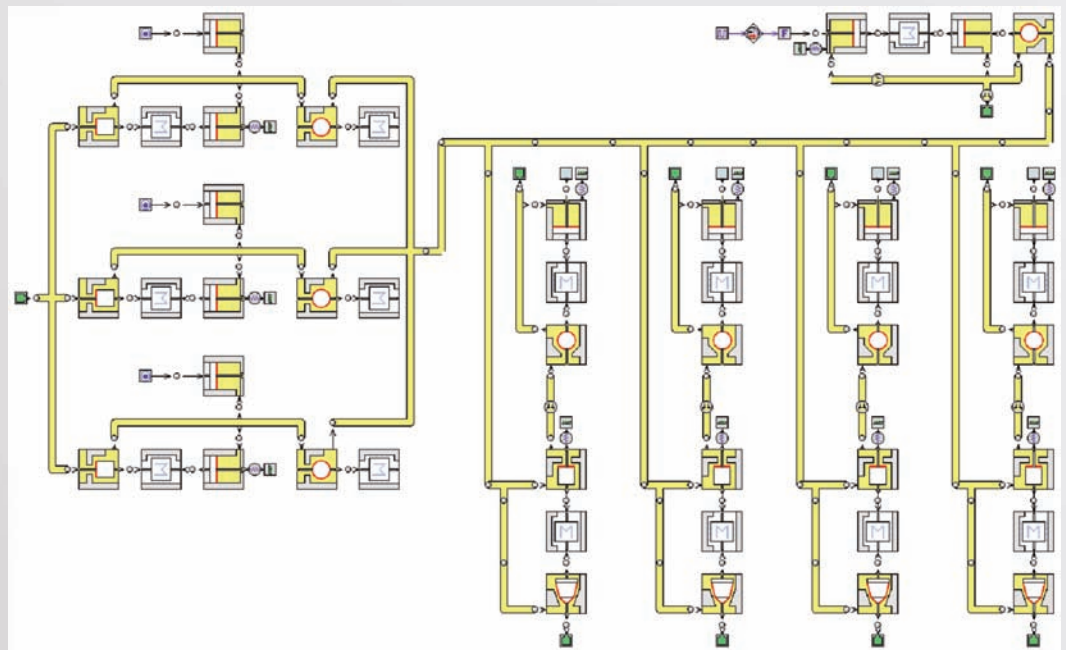
• Fuel Injection

- o Common rail, direct/port injection, unit injectors, pump line-nozzle
- o High and low pressure systems and their interaction
- o Diesel, gasoline, and other alternative fuels (E85, DME, LPG, etc.)
- o Solenoid, piezo, electro-hydraulic, or mechanical actuation

• General Hydraulics

- o Hydraulic valvetrains, cam phasers, engine compression release brakes
- o Mobile hydraulics
- o Braking, power steering, and wet clutches

Detailed component modeling is facilitated by the flexible higher-level fluid-mechanical templates (FMTs), which model fluid structure interaction. They allow rapid building of any injection or hydraulic model. **Users can also create their own library** of compound components with an easy-to-use graphical programming method or with user subroutines.



Common rail system with detailed high pressure pump and injectors built from FMTs.

Advanced Features and Applications:

Injection

Detailed solenoid or piezo actuator models with electromagnetic library

3-D MBD with EHD solution at all contacts (detailed pump analysis)

Detailed helical and spur gear models for timing drive analysis

Rigid, torsional, or bending options for injection pump cam shaft

Detailed journal bearing models

General Hydraulics

Integrate hydraulics with detailed GT-POWER engine model

Geometrically based predictive pump models

Detailed cam phaser and spool valve templates

Mobile Hydraulics

2-D or 3-D multi-body dynamics linked to hydraulics

Integrate hydraulics with detailed or mean value GT-POWER engine models for fuel economy and thermal management

Physical Models

The GT-SUITE flow solver provides a solution of the compressible **1-D Navier-Stokes** equations (conservation of mass, momentum, and energy). Being built on fundamental principles, it can accurately model mixtures of species. This is important to modeling of cavitation and aeration (dissolved and free gases), and **tracking of these vapor species** as they move through the system. It is thus exceptionally adapted for applications to modern high pressure common rail systems (>2500 bar). Of particular importance is that it always solves the energy equation which gives it a key advantage over "isothermal" solutions.

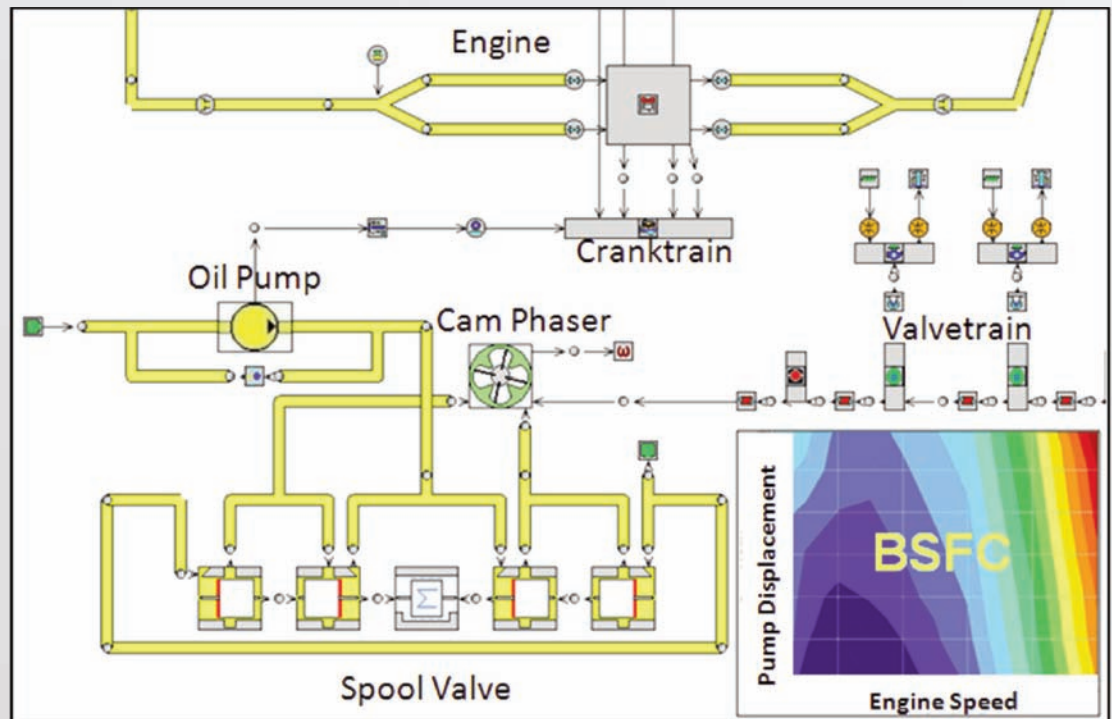
Fast Solver

Despite the level of detail that it offers, GT-SUITE provides **the fastest solver on the market**. The speed advantage is particularly prominent in large multi-component system simulations.

System Integration - Hydraulic Valvetrain and Cam Phasing

For hydraulic valvetrain and engine compression release brake applications, integration of the hydro-mechanical system with the detailed GT-POWER engine model is of paramount importance; instantaneous cylinder and port pressures affect the valve lift, and the converse is also true. With GT-SUITE, the **easy integration** enables automatic handling of these interactions and system level optimization within a single tool.

GT-SUITE is uniquely capable of **system level optimization** for cam phasing applications. Oil pump size can be optimized to reduce BSFC with constraints on phaser response time. This type of simulation requires a model of the cam phaser, spool valve and oil circuit. Additionally, a detailed valvetrain is required to calculate shaft torques on the phaser. Finally the engine model is required to calculate BSFC. All these systems can be modeled in GT-SUITE, and the user can choose from many levels of detail for each system.



System Integration – Injection and Combustion

Predictive injector models are easily integrated with GT-POWER, whose combustion model predicts heat release rate, NO_x, and other quantities based on the injection profile. This combination allows a **simultaneous analysis and optimization of injection and combustion**.