Valvetrain Design Analysis

Valvetrain Dynamics and Kinematics, Cam Design

GT-SUITE features a complete set of tools for valvetrain engineering in a single integrated environment. Using these, engineers can focus on valvetrain design issues such as stability, durability and noise, as well as inherent tradeoffs between engine breathing and mechanical design objectives.

The GT-SUITE valvetrain analysis functionality is based primarily on three underlying general-purpose libraries:

- General planar kinematics
- Multi-body Dynamics (MBD) : 1D/2D/3D/Flexible bodies
- Valvetrain component toolbox

The valvetrain toolbox is a library of specialized “expert-system” valvetrain components built on top of MBD elements and with many ease-of-use and automation features. They are described in valvetrain engineering terms, and in simulations produce a large number of valvetrain engineering outputs and metrics. They can be mixed with basic MBD components to model unconventional or advanced valvetrain systems.

VTdesign GT-SUITE’s user-friendly interactive facility for cam design, kinematic and quasi-static analysis is based on standard topologies and their variations. It can be used for analysis of all common valvetrain types, without “building” models. VTdesign also creates a corresponding GT-SUITE MBD model with a single click.
Valvetrain MBD simulations produce output rich in information, including time plots of hundreds of quantities per valvetrain branch, in-depth durability-oriented predictions for springs and contacts, HLA transient pump-up/pump-down, valve overlap, valve-piston interference and spring margin metrics. Models can be visualized and dynamics of valvetrains can be animated.

GT-SUITE’s General Planar Kinematics and MBD libraries extend the reach of GT-SUITE to mechanism synthesis/design and dynamic analysis of any VVA or other non-conventional mechanisms, including valvetrains with 3-D geometries, embedded HLAs, dual cams and others.

Models can be easily extended to cover entire valvetrain systems coupled to camshaft torsional or bending vibrations, thus enabling analysis of whole-system issues and variations/interactions between cylinders. Dynamics and hydraulics of cam phasers may be also included in such models.