What is Virtual Engine?

Virtual Engine is an advanced simulation software for dynamic analysis of complete powertrain and its components. It provides all building blocks needed to create dynamic models of powertrains including cranktrain, valvetrain, piston and rings, bearings, timing and accessory drive, geartrain and driveline. Virtual Engine uses the core technology of the world leading Multi-Body-Simulation Software MSC Adams® as numerical integrator, pre- and post-processing features. The template based architecture perfectly combines the advantages of single purpose software - ease of use and multi-purpose software - no limitations in extendibility. Virtual Engine is a truly open system – featuring a powerful scripting language for task automation, the ability to customize the user interface, support for own solver routines and extending the modeling component library with own user-defined elements. Wizards automate and accelerate the creation of complex models like crank and drive trains. Models and corresponding data are organized in databases, strengthening data management even for global scale companies. Advanced generic 3D contacts plus fast analytical approaches for powertrain-specific contacts ensure a vast scope of application.

With its advanced simulation tool “Virtual Engine” FEV provides

- In shorter time
- Low cost
- High quality

Powertrain development.

Based on the state of the art GUI, solver and post-processing technologies of MSC Adams, Virtual Engine is

- Easy to use in:
  - Model set up and simulation
  - Post-processing and result reporting
- Intuitive in workflows, fitting powertrain engineers’ needs
- Integrated easily into existing processes
- One for all:
  - One environment for all analysis
  - One model for all phases of the development
- Proven technology: fast, reliable, and validated

The unique communicator technology and the template-based architecture support modular modeling.
From components to system level simulation

Virtual Engine provides a modular modeling approach. One can build and analyze individual subsystems, which may consist of one component only or more. Virtual Engine is a so-called template-based product: every subsystem is derived from a template, which acts as blueprint for the subsystem and defines it’s topology. Subsystems can be adjusted and refined to different fidelities as appropriate for the desired analysis. The unique communicator technology and the exceptional template-based architecture enable both modular and scalable modeling that correspond to both user’s experience and functional simulation demands. Using the communicator technology complete powertrain can be built with the subsystems and run as a fully coupled model.

CRANKTRAIN ANALYSIS

Virtual Engine supports modeling and simulation of all cranktrain types.

Virtual Engine supports modeling and simulation of all cranktrain types including inline, V-type, VR-type, W-type or Boxer-type engines. Any type of cranktrain can be built in a few minutes using the Cranktrain Wizard, making it possible to create each component – from crankshaft to piston pins on the fly. The resulting model as well as the individual parts can be refined in depth using rigid, torsional, beam or fully flexible bodies. An integrated Gas Force Wizard allows creating gas pressure curves from basic thermodynamic parameters.

> Load prediction
> Firing order optimization
> Crankshaft torsional vibration analysis
> Crankshaft stress analysis
> Cranktrain balancing
> Connecting rod analysis

VALVETRAIN ANALYSIS

Virtual Engine supports multiple variations of valvetrain design.

Virtual Engine provides a high degree of freedom in modeling and simulation. The Valve Lift Designer allows design and optimization of lift curves with respect to velocity, acceleration and jerk. All Valvetrain types including CVVL can be analyzed kinematically or dynamically. Valvetrain models are created in a unique two-step process from ‘single’ to ‘complete’ valvetrains with flexible components if desired. Virtual Engine’s unique communicator technology allows building complete valvetrains on the fly by assembling multiple single valvetrains via a camshaft.

> Cam profile design
> Optimum layout for best gas exchange
> Maximum possible speed and seating velocity
> Dynamic valve spring behavior
> Friction prediction
> Contact forces and hertzian pressures
> Cam driving torques

PISTON AND RING-PACK ANALYSIS

Virtual Engine predicts dynamics of the piston ring pack, piston, piston pin and connecting rod assembly.

Virtual Engine has advanced 3D simulation features to predict dynamics of the piston ring pack, piston, piston pin and connecting rod assembly. It allows analysis of the piston secondary dynamics, the impact of the crankshaft and/or piston pin offset on friction and resulting NVH through piston slap. Boundary lubrication and asperity contact are calculated based on the Greenwood and Tripp method. The 2D hydrodynamic approach uses a simplified version of the Reynolds equation, thus providing fast solutions. The comprehensive full 3D elastohydrodynamic solution addresses the high fidelity piston assembly simulation needs.

> Piston slap & NVH analysis
> Friction & wear prediction
> Skirt profile and pin offset optimization
> Ring pack optimization
From components to system level simulation

Virtual Engine and Adams Car share the template based architecture that perfectly combines the advantages of single purpose software - ease of use and multi-purpose software - no limitations in extendibility. Given the same template based architecture and communicator technology Virtual Engine’s powertrain model can be directly coupled to Adams Car’s vehicle model and this complete powertrain and vehicle system level model can be simulated dynamically.

Virtual Engine builds complete, multi-staged timing and accessory drives
Virtual Engine allows building complete, multi-staged timing and accessory drives, comprised of mixed chain and belt drive stages. Building blocks are provided for the Chain/Belt Drive analysis: chain types including bushing, roller, silent/inverted tooth, sprockets including circular or non-circular using external CAD geometry, involute sprockets for silent/inverted tooth chain, fixed, translational, pivot and flexible chain guides, hydraulic tensioner, toothed belts, ribbed belt such as Poly-V belt, circular and elliptic idler/pulley, and tensioner. Even complex belt and chain drive templates can be easily created with the Chain/Belt Template Wizard.

- Timing and accessory drive design
- Chain / Belt dynamics
- Belt life prediction
- BSG start-stop systems
- Drive layout
- Tensioner system analysis

Virtual Engine provides complete tool set to build any type of geartrains and transmissions
Virtual Engine provides complete tool set to build any type of geartrains, analyze them using either 2D or 3D advanced gear EHD contacts and assemble them with other subsystems. Gears may be used to build gearboxes or transmissions, but can also be part of multi-staged timing or accessory drives. External or internal, spur, helical, scissorers and planetary gear sets can be modeled using rigid or flexible modeling elements.

- Transmission error and resulting speed irregularities
- Gear whine & rattle
- Backlash Studies
- Tooth Loads

Virtual Engine has different fidelity levels bearing models
Virtual Engine provides journal and roller element bearings in different fidelity levels. Available bearing types include linear, non-linear, mobility, hydrodynamic, elasto-hydrodynamic (EHD) and thermo-elasto-hydrodynamic (TEHD) models. Advanced bearing model types are based on Patir and Cheng average flow model where flow factors can be calculated if a measured surface profile is available. Asperity contact calculation has two options one being Greenwood & Tripp model an additional option is provided based on a measured surface profile.

- Minimum oil film thickness
- Maximum oil and contact pressure
- Displacements
- Friction prediction
- Wear prediction
Are you interested in innovative and trend-setting software solutions?

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