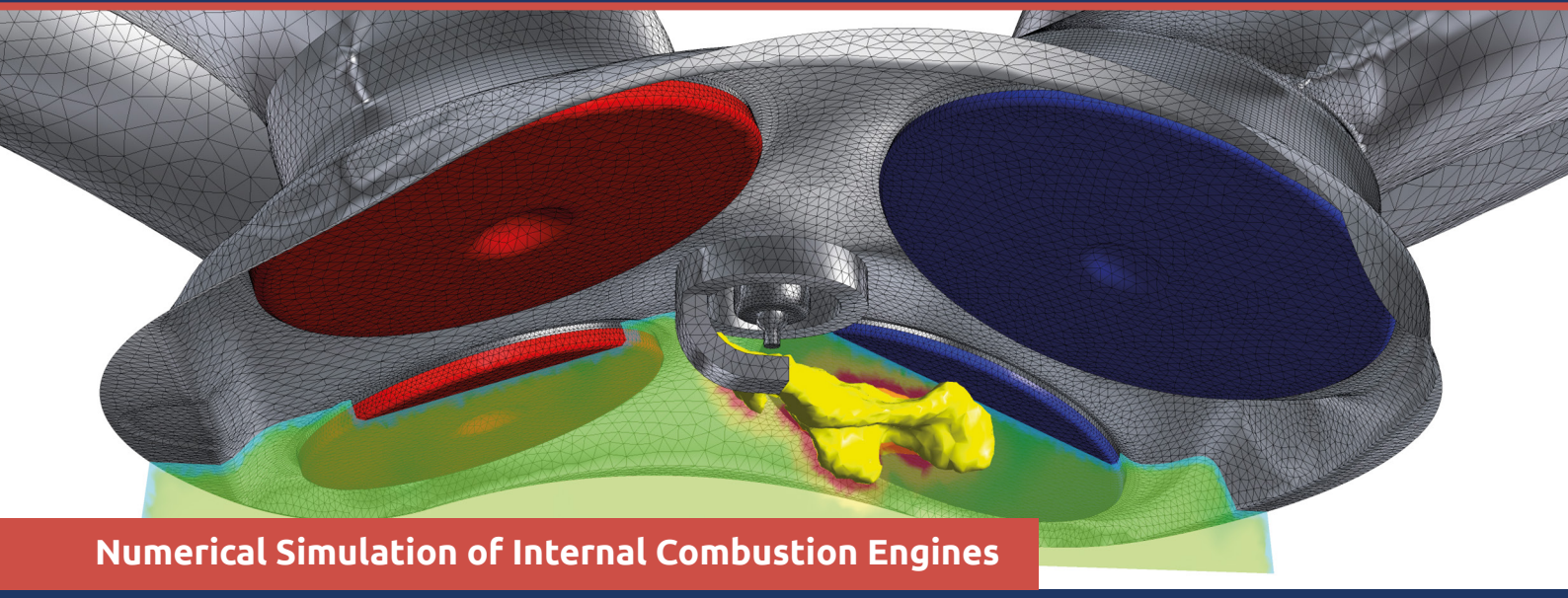


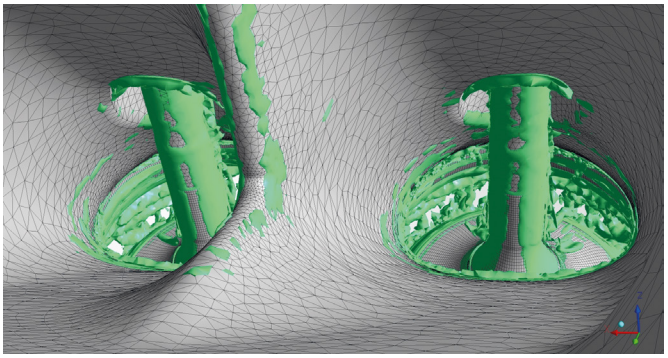
Numerical Simulation of Internal Combustion Engines

Constantly reduced pollutant emission limits and increased demand for efficient engines put pressure on every engine manufacturer. Already established concepts like SI and CI engines, as well as new combustion methods like dual-fuel (DF) or high-pressure natural gas direct injection (HPDI) need further improvements to be all set for new emission legislation and competing mobility technologies. The Germany based FVTR company offers a wide range of numerical simulation tools and models to improve your engine and increase your knowledge about the internal chemical-physical processes.

Numerical Simulation of In-cylinder Processes: Options and Opportunities

The physical processes with IC engines range from the turbulent flow field to fuel injection all the way to combustion and pollutant formation. To benefit from simulation results, the modeling of every subprocess has to be very precise but using this technologies within the product development process, it opens many opportunities:

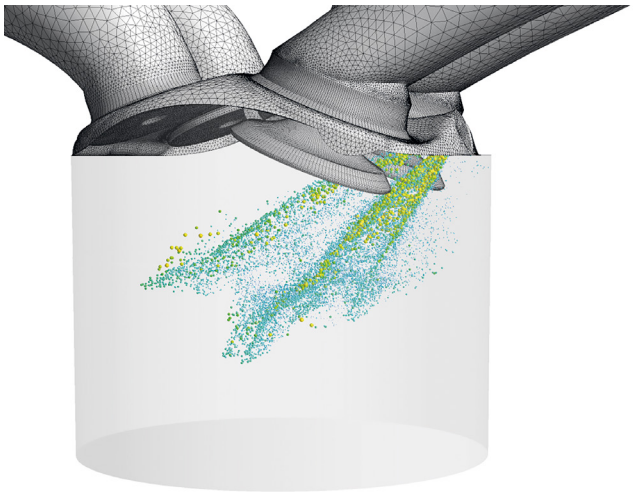
Fast design and dimensioning in the early product development lowers the costs due to less prototyping and experimental work. In a later stage, modern simulation tools can give insight into physical processes to better understand the overall product.



▲ *Turbulence generated at the intake valves of a DISI engine*

Optimizing charge motion, mixture formation, intake- and cylinderhead geometries, combustion and injection timings, pollutant formation … there are nearly unlimited possibilities to boost up your IC engine using numerical simulation.

Our Simulation Tools and Models



▲ *Fuel injection at the intake stroke using Lagrangian approach*

We use a whole set of numerical tools and methods to help our customers reaching their goals:

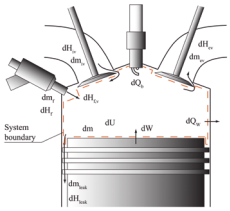
- 0D/1D simulation to quickly estimate important key parameters of new engine concepts
- 3D CFD simulations to gather detailed information about the influence of specific engine relevant parameters, which cannot be established using an experimental setup e.g. flowfield simulations, heat flux calculations
- Advanced turbulence/combustion models to study complex phenomena e.g. cycle-to-cycle-fluctuations
- Detailed chemistry to analyze advanced combustion concepts (DF, HPDI) considering different complex chemical paths

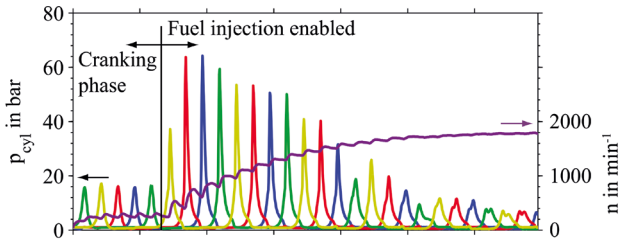
FVTR GmbH • Joachim-Jungius-Str. 9 • D-18059 Rostock • CEOs: Dr.-Ing. Martin Theile, Dipl.-Ing. Martin Drescher

APPLIED THERMODYNAMICS

0D/1D Simulations Methods

- In-house and commercial 0D/1D tools available
- Fast model development / results available
- Advanced models (i.e. combustion) can be handled

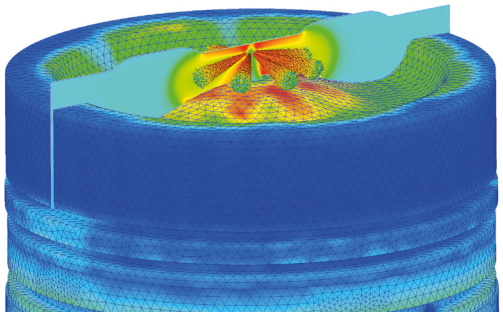




▲ *Simulation of the cold start event of a gasoline engine*

3D CFD Simulation

- Simulation of complete cycles including gas exchange and combustion
- From Diesel to SI / from automotive to marine engines
- Combined CFD-CHT for heat flux calculations
- Clear visualization and result interpretation



▲ *Analysis of the temperature field of a diesel piston*

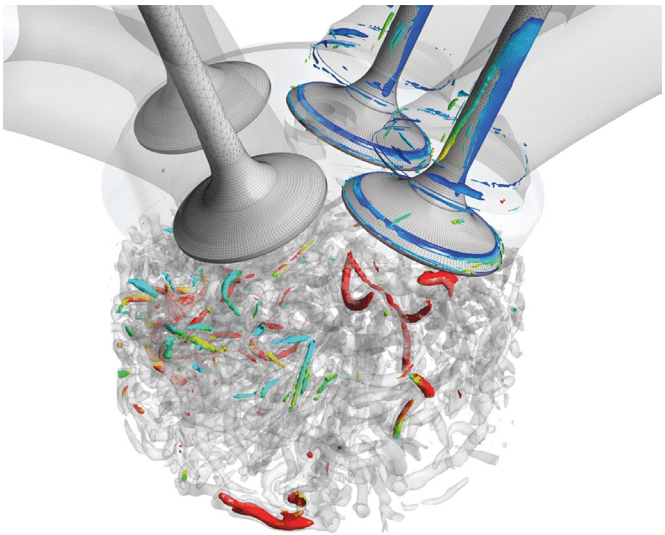
Key Benefits for Your Project

- Long-term experience in using commercial and in-house codes to analyse internal combustion engines
- State-of-the-art computing equipment ensures valueable results within short time frames
- Scientific based model development and analyzation methods
- Professional and efficient project management in addition to direct communication with responsible operators
- Tailor made consulting and detailed reports support you in your decision making

Are you interested in further information?
Feel free to contact our friendly experts.
Together we will find a solution for your challenges.

Large Eddy Simulation

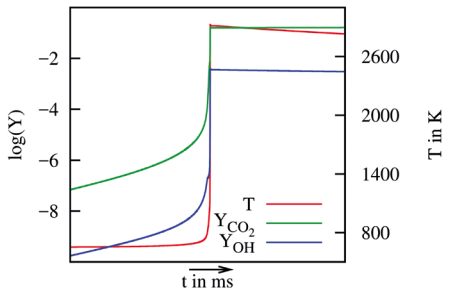
- Advanced simulation methods to analyze cycle dependent phenomena
- State-of-the-art post-processing tools to get as much information from the flow field as possible

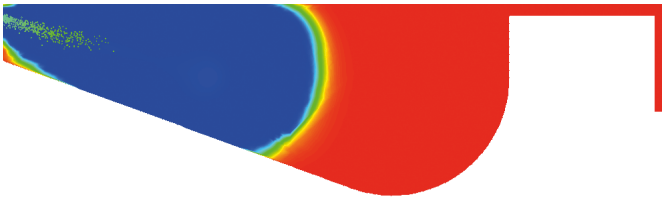


▲ *Turbulent structures in a DISI engine at intake stroke*

Chemical Reaction Kinetics

- Detailed insight into combustion processes via reaction path analysis
- Modeling and analyzation of complex combustion processes (e.g. dual-fuel)





▲ *Simulation of dual-fuel combustion using detailed chemistry*

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