

FEV Signature Solutions

AI transformation in simulation

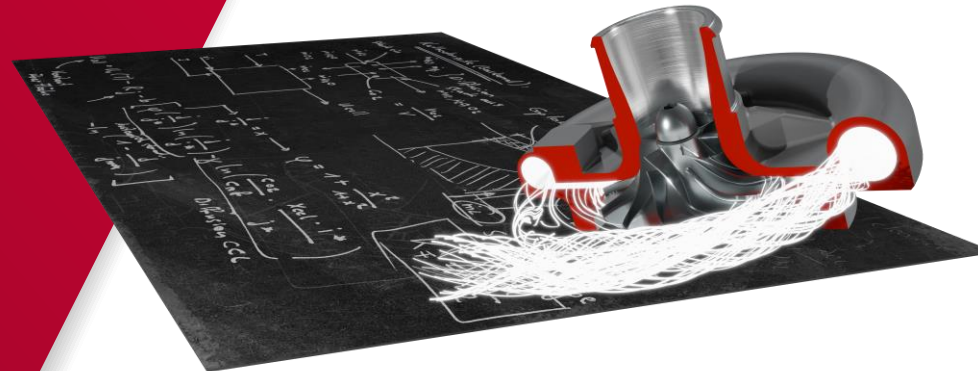
Reduce time and costs in your simulations

FEV offers

- ▶ Comprehensive AI-enabled simulation assets combining automated workflows, AI/ROM/PINN solver acceleration, optimization & control co-design, scalable validation, and multi-physics modeling – from component to full system.
- ▶ Broad application coverage, including CFD acceleration, FEM model validation, system design, digital twins, architecture definition, and virtual use-case evaluation.
- ▶ Tool-chain integration, supporting early concept exploration, design space evaluation, system sizing, control parametrization, and final validation.
- ▶ Flexible delivery: available as stand-alone simulation tools for customers or as FEV-executed engineering services delivering fast, validated simulation results.

Why FEV

- ▶ 45+ years of automotive engineering excellence, trusted by global OEMs and Tier-X suppliers
- ▶ 20+ years of experience in system optimization and control strategies
- ▶ Deep experience in applying AI to real-world engineering challenges
- ▶ Customer-centric solutions, enabling you to extend, integrate, and scale your own development



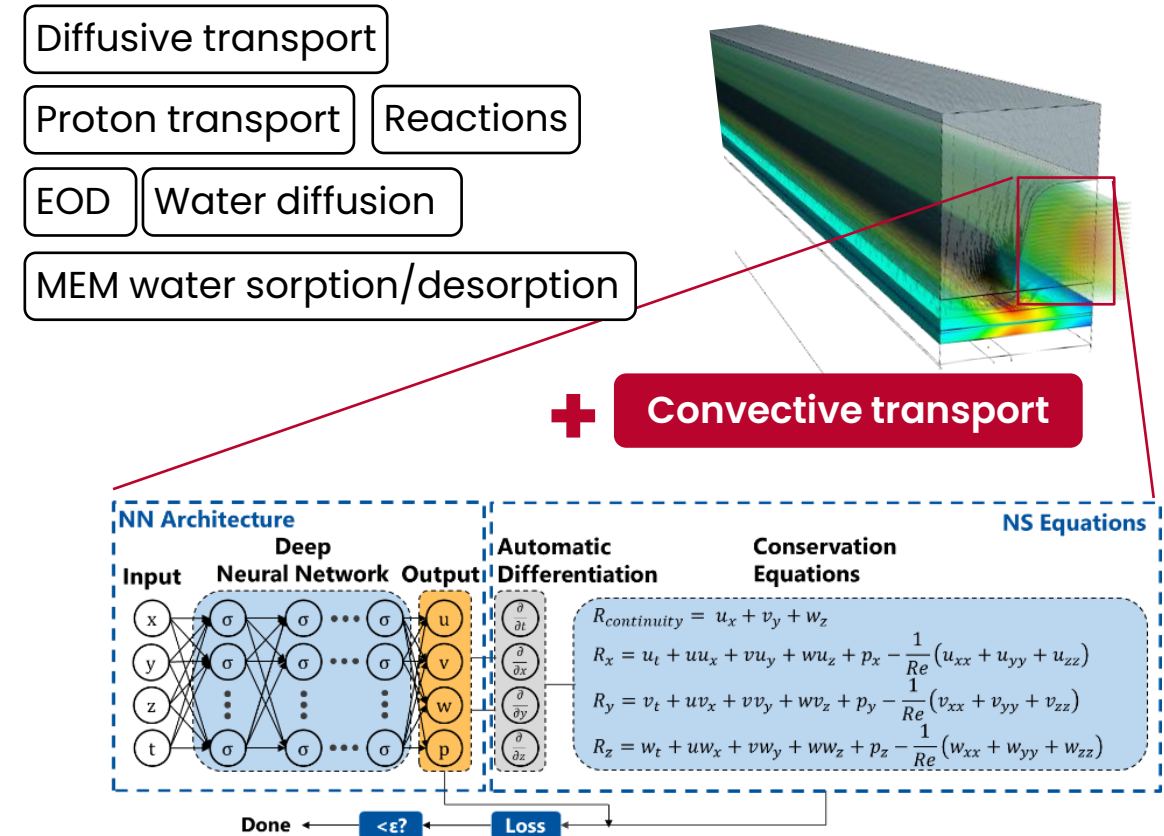
Substitution of numerical solvers to save costs or to enable efficient multi-physics simulation

REFERENCE: INTERNAL RESEARCH PROJECT ON FUEL CELLS

BACKGROUND: Simulation time is reduced by magnitude of orders which saves costs and time. Approach is key enabler for (holistic) multi-physics model.

Results

- ▶ AI based solver for complex physical equations
- ▶ Use of Physics-informed neural networks in FEV's toolchain
- ▶ Reduced computational time and costs drastically by accelerating solution of complex equations (e.g. partial differential equations)
- ▶ Flexible computations reduced in time from hours to minutes
- ▶ Multi-physics fuel cell simulation with all relevant physics and electro-chemistry achieving 95 % accuracy in prediction of the polarization curve

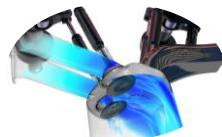


>25% Saved simulation cost

With our AI solutions for simulation, we can optimize the design process from component to complete system level in a cost and time efficient way



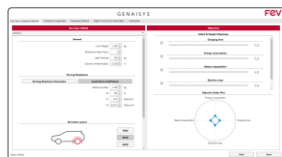
**Architecture and
concept definition**



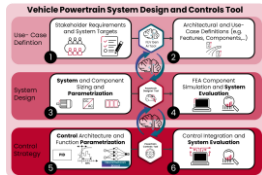
**Solver substitution/
acceleration**



Digital twin



**Virtual system
development**



**System
optimization**



**Workflow
acceleration**

FEV offers flexible AI simulation solutions applicable for various tasks, especially



Exemplary use cases

BENEFITS OF AI IN SIMULATION

AI-based vehicle powertrain system design and controls optimization

Challenge

System development suffers from multi-dimensionality of conceptional solutions in control and design domain regarding derived use-cases

Solution

FEV integrated system design and controls in its system development methodology and tool

Benefits

- Leveraging frontloading capabilities and cost reduction potentials by early phase design and control parametrization
- Optimization hierarchically in virtualized use-case environment by overarching AI interfaces
- GenAI support of use-case and architectural derivation from stakeholder requirements

Solver acceleration by combination of AI and conventional CFD

Challenge

AI surrogate model such as Physics Informed Neural Networks can substitute conventional CFD but lack accuracy

Solution

Reduced Order Modeling (ROM) AI is used to initialize conventional CFD

Benefits

- Maintaining conventional CFD accuracy with significantly improved throughput
- Ensures convergency and result quality of conventional process
- Has potential to provide simulation results within much shorter time

Feasibility check of FEM simulation models

Challenge

Validating contact mechanics is often a bottleneck in the engineering workflow

Solution

AI-driven assessment, effectively isolating specific contact anomalies via outlier detection

Benefits

- Reliable method for automating quality checks in structural analysis
- Handles the severe non-linearities of complex FEM models
- Accelerates the model validation to ensure correct models significantly

Get in touch with us for further information



[www.fev.com/en/
signature-solutions](http://www.fev.com/en/signature-solutions)