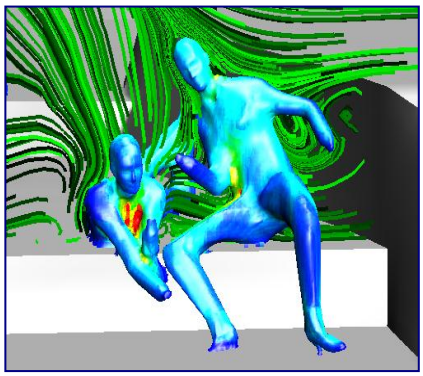
AVL FIRE ® General Purpose

Solutions for better products

AVL FIRE is a powerful multi-purpose thermo-fluid software. It represents the latest generation of 3D Computational Fluid Dynamics. FIRE offers the highest flexibility in regard to the supported grid types due to its Arbitrary Cell Type technology. Fluid flow simulations on the basis of meshes with polyhedral elements, arbitrary and sliding interfaces or hanging nodes are performed in a natural manner without penalties in simulation time or accuracy.



Outstanding features, outstanding performance

AVL FIRE was developed to solve the most demanding flow problems in respect to geometric complexity and chemical and physical modeling. The software reflects the latest achievements in regard to grid generation and solver technology as well as the graphical user interface design.

The pre-processor of AVL FIRE, offers a flexible, yet automated 3D grid generation tool that provides computational models containing mainly hexahedral elements. A single wall boundary layer is created automatically. On user request it can be subdivided in an arbitrary number of thinner layers with specified thickness. A wizard guides the user through the setup of the grid generation process giving him full control over all steps. The tool is highly efficient and it provides computational models containing a minimum number of elements thus contributing to short simulation time. Grid refinement is performed either automatically depending on the local differences in the normal vectors of the surface patches (model curvature) or on user request in specified regions anywhere in the 3D domain. In subsequent steps these generated grids can be assembled to more complex domains using arbitrary and sliding interfaces or they may become part of a mesh set representing a domain with a moving boundary. These processes are also wizard guided and fully automated.

For the most accurate solutions the FIRE solver uses a pressure based segregated solution algorithm. Implicit time discretization schemes are first or second order accurate. First, second and third order accurate conservative and bounded differencing schemes are offered. Excellent accuracy and stability is given by a two stage pressure correction.
Multiple choices exist for turbulence modeling, ranging from the well-known and commonly used k-ε model via AVL's Hybrid Turbulence Model (HTM) to an industrial implementation of the Reynolds Stress Model (RSM). The latest development in that field is the k-ζ-f model which is also suitable for highly compressed flows in domains with moving boundaries. It also provides very accurate solutions efficiently for separating and swirling flows. Enhanced wall treatment models are available as well.
Multiple types of inlet, outlet and wall boundary conditions including such for trans- and supersonic flows are offered enabling a simulation setup matching the real conditions.

Other features offered by FIRE are:

- steady and transient (time stepping) simulation mode
- compressible and incompressible, laminar and turbulent flows
- user defined fluid properties
- handling of domains with and without moving boundaries
- Multiple Frame of Reference (MFR), mixing plane and sliding interfaces for rotating parts

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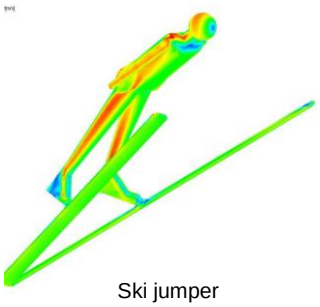
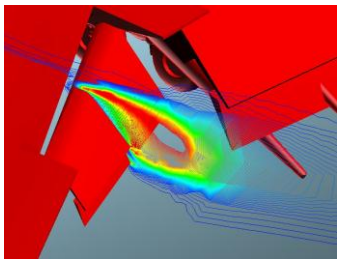
Furthermore FIRE *General Purpose* includes:

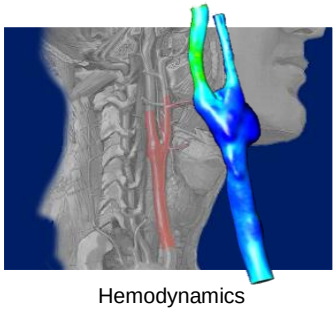
AVL Code Coupling Interface (ACCI): The AVL Code Coupling Interface enables multi-domain, multi-fluid and multi-physics simulations to be performed. For example ACCI allows handling single phase and multiphase problems at the same time. When using ACCI it is not required that the computational grids representing the different domains are connected with each other, neither conform nor by means of arbitrary interfaces. The grids can be completely independent from each other and of different types. Multi-physics simulations even allow using grids that overlap or intersect each other.



Ski jumper



Aircraft wing



Hemodynamics

Conjugate heat transfer: Conjugate heat transfer simulations may be performed either by applying the native implementation of this feature or by using the ACCI interface. In contrast to other solutions on the market the later approach allows handling of an arbitrary number of fluids and solids.

General gas phase reactions: The general gas phase reaction module allows the simulation of various types of kinetic problems by interfacing property and reaction databases.

Porosity module: The porosity module allows handling of flows through filters, heat exchangers, catalysts, etc. without having to model the fine-scaled geometrical structures of these parts. The pressure loss in the porous medium is determined by applying a flow resistance model and parameter supplied by the user. In addition to each pressure drop model the 'heat exchanger functionality' can be activated enabling the modeling of the heat transfer between the simulated fluid and the virtual cooling or heating fluid.

Radiation: The radiation module allows heat radiation to be simulated through transparent and participating media based on the discrete transfer radiation method.

Single phase boiling: The single phase boiling model allows boiling effects to be accounted for without having to perform a multiphase flow simulation and hence saves computing time and resources. FIRE offers two single phase boiling models, the 'Chen model' and the 'Bubble departure lift-off model'.

Species transport: The module provides the necessary transport equations for gas phase chemical species in the computational domain.

Thin walls: The module allows modeling of wall boundaries as thin multi-layered walls for which one-dimensional heat conduction is solved. This way wall thermal resistance and inertia is taken into account simply.

User-defined functions: User-functions offer access to most parts of the code for modification or even replacement with user defined models. Typically user-functions are applied for special input and/or output definition, but also for initialization or boundary condition definition.

The available functions and features make the FIRE *General Purpose* package the first choice for a wide range of simulation tasks. To expand its applicability beyond the general scope AVL offers a number of optional modules.

Aftertreatment	De-icing / De-fogging	Multiphase, Lagrangian
Coupling 1D/3D	ICE physics and chemistry	PEM Fuel cell
Coupling CFD/FEA	Multiphase, Eulerian	

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