What's New in FEFLOW 7.1?

FEFLOW 7.1 features a substantially extended range of functionality compared to previous versions. This page presents the highlights of the new release in an overview of the most important new features and improvements:

Discrete Feature Elements (Revisions and Extensions)

The entire concept of **Discrete Feature Elements (DFEs)** has been revised in this FEFLOW release. Now DFEs becomes an entity of the finite-element mesh in FEFLOW, which allows to display common information (material properties) shared by multiple DFEs. This option simplifies the navigation through the Data panel and increases substantially the degree of flexibility to create, edit and delete this lower-dimension finite-elements.

The extensions include the support of DFE node-decoupling (flow, mass and heat). This is achieved by introducing the concept of a **Dual Node Connector (DNC)** in FEFLOW. Each connecting node in between a DFE and a finite element has now the possibility to include its dual node and its connector (1D element). The transfer of fluid, mass and heat in between the DFE and the finite element is controlled by the DNC, which requires an exchange coefficient and an exchange length. The new DNC in FEFLOW increases the range of applications such as impermeable fractures, coupling processes between surface/subsurface, etc.

Coupling Groundwater and Surface Water

A FEFLOW finite-element problem can now be coupled to our surface water engine MIKE 21 Flow Model FM. Now FEFLOW can prepare automatically the required information for the coupling. The finite-element mesh can be exported to a *.mesh file that MIKE21FM can later on process. The information required for the coupling (*.pfs file) such as simulation times, domain information, solution techniques, etc. can be also exported from FEFLOW.

Visualization of Surface Water Bodies

FEFLOW extends its 3D visualization capabilities by introducing the display of surface water bodies in the 3D View. Based on the information of nodal parameters such as Hydraulic Head, Pressure, Hydraulic-Head BC and Fluid-Transfer BC, FEFLOW is able to compute a surface water body to represent the phreatic level. This surface can be extrapolated in locations even outside of the model domain.

Improvements in Mesh Generation

In the context of adding higher flexibility in the 3D mesh generation, we have introduced more options to increase the usability. Point add-ins for 3D mesh remeshing are handled now in a different manner. FEFLOW can identify the proximity of these points to the existing mesh nodes and smartly decide whether (or not) to consider these new nodes. Such approach can reduce significantly the number of nodes/elements in the output mesh and minimize the effort of preprocessing the input geometry (e.g. external map files) used for the remeshing.

The ***3D Layer Configurator*** has extended its capabilities for building 3D finite-element meshes by a method to generate gradual changes of the layer thickness. Based on a prescribed number of additional slices and a gradation factor, FEFLOW can split an existing model layer thickness in a gradual manner. This option is extremely relevant for cases, where a variable vertical refinement is required such as unsaturated-flow models, mass transport problems, among others.

We have included additional convert methods to extend the finite-element library in FEFLOW. Now it is possible to convert from hexahedra to pyramids and from tetrahedra to hexahedra. These additional elemental topologies extends even more the FEFLOW capabilities for 3D fully-unstructured domains allowing the user the maximum flexibility for the most challenging geometrical (and hydrogeological) configurations.

The migration from an old standard layered model to either a partially-unstructured or fully-unstructured model is more and more popular within the FEFLOW community due to the several existing benefits with

the new mesh topology. To facility this migration to tetrahedral meshes, we have included new elemental-interpolation methods, which can be used to transfer the information of material properties to the new mesh.

New 3D Selections Tools

To assure the maximum flexibility for assigning properties in 3D models (either layered or fully-unstructured), we have extended our options for 3D selections tools. Now you can select any of the FEFLOW topologies (nodes, elements, edges and faces) using selections tools by rectangular region, lasso and polygonal region in the FEFLOW 3D View. A combination of clipping and carving settings from the Planes Panel with any of these selections tools can help you to reach even the most farthest corner in the 3D domain.

A new selection tool has been added to the list, **Select Mesh Items by Value**. The tool complement the operation of a selection by expression and any interatively-selection tool. The selection tool allows the creation of selection sets based on certain reference value of any FEFLOW parameter, a tolerance (relative or absolute) and a buffer (neighbour elements) can be also defined.

Additional Map Functionalities

The task of adding a map file to the model domain cannot be done even easier now. Map files can be simply dragged-and-dropped to any location of the graphical interface. FEFLOW will properly locate the dropped map file in the Maps panel. If the file is dropped on the active view, this one will be displayed automatically.

FEFLOW export list includes now the support of *.vtk and *.vtu generic file formats for the selection sets.

Recording of Model Content Information

Using stored elemental selection, FEFLOW can record now as a time-series charts, the content information for all the problem classes (Fluid, Mass, Head and Age). This feature extends the functionality from the Content panel.

New Scripting Menu and more

The interest of the FEFLOW Python interface has steeply increased in the last years. Many users have found their way to optimize modelling workflows and more. In this FEFLOW release we introduce the concept of the new scripting menu in the graphical interface.

Scripting capabilities are now possible directly through the FEFLOW GUI. Scripts can be saved and become part of the FEFLOW document. This allows automatic execution of user-defined scripts when the FEFLOW document is loaded, during the simulation and more.

We have started with the first milestones to control the graphical interface via the **Scripting menu**. FEFLOW documents can be loaded, manipulated and closed from the new **Execute Python command** console. Such options will allow the user to modify multiple FEFLOW documents with a few lines in Python.

New Features in FePEST

The release of FEFLOW 7.1 includes also additional features associated to our PEST Graphical Interface for FEFLOW models, FePEST. Below you can find a list of major features:

- New Operation Mode: Pareto Front
- New options for slave configuration in the parallelization section
- Generation of pilot points based on FEFLOW Points Sets (2D and 3D)
- Stability test (JACTEST utility) is now parallelized
- Advanced run options
- Support of parameter definitions based on unsaturated-flow model type

Additional functionality

- Customizing the appearance of the graphical interface
- Additional auxiliary parameters (Fluid Viscosity, Courant-Friedrichs-Levy Number, Pseudo-saturation for 3D phreatic models)
- Minimum time-step control in Predictor-Corrector Schemes
- Improvements for the generation of 3D Point Sets

Programming Interfaces IFM & Python

New functions for budget calculations:

IfmGetBudgetComputeNodal
IfmBudgetComputeSubdomain
IfmGetBudgetComputeSubdomainTransfer

New functions for discrete feature elements

IfmCreateFracElement2

New functions for accessing parameters

IfmGetParamSize
IfmGetParamValue
IfmGetParamValues
IfmSetParamValue
IfmSetParamValues
IfmResetParamValues
IfmEnableParamRecording