

Welcome to FieldView 2023

11/7/2023

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Revision 2023
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First Printing November 2001

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The FieldView 2023 Release at a glance

This **FieldView** release contains the following new features and improvements:

Introducing Client/Server Autostart for HPC systems

A new feature has been added to make it easier for users running the FieldView Client locally to connect and run FieldView Servers on remote HPC systems via **job queues**. This is now automated by using FieldView's Server Configuration (.srv) files, where previously, additional shells needed to be opened to submit jobs to the queue while running FieldView with the manual server option.

New Capability - Show Surface Localized Min/Max

With FieldView 2023, a new feature is provided on the Surface Panels which allows you to turn on markers and annotation to identify the locations of the minimum and maximum values of a scalar quantity on a given surface.

New User Defined Function atan2

Function atan2 is now supported for User Defined Formulas. It is especially useful for computing local angle of attack based on a velocity field.

New Display Option Polyspheres for Particle Paths

A new Display Type named Polyspheres has been added for Particle Paths. It should be used when the user favors an accurate intersection with surfaces over graphics performance.

The VTK reader has been largely improved in FieldView 2023.

The VTK reader library has been updated to version 9.2, and our VTK Data Input options now provide support for VTI (VTK Image files), and IBlanking information in VTK files.

Improved Transient Capabilities for Data with Changing Grid Counts

Adaptive Mesh Refinement (AMR) often yields data which is composed of different grid counts over time. Some FieldView readers (data loaders) are able to detect and handle this. For data loaders where this handling is not automatic, a new option is provided to accept such data.

Tecplot 360 and Ensight readers are more visible

FieldView's *Generic Unstructured* reader has been replaced and now provides two new input options, *Tecplot 360* and *Ensignt*, each having their own file filters *.plt* for Tecplot 360, and either *.case* or *.encas* for Ensight.

Other Important New Features

See this section for details on other significant changes and improvements with this release

List of Resolved Issues

See our list of Resolved Issues following our descriptions of New Features.

Introducing Client/Server Autostart for HPC systems

FieldView's Automatic Server start for the Client-Server Mode has been extended to support HPC environments. Once all the relevant settings have been entered into a Server Configuration file, it will only take a single click to get FieldView Server(s) to run on Compute Node(s) through a job scheduler submission on a Login Node, and establish communication back to the FieldView Client across firewalls through a double port tunnel.

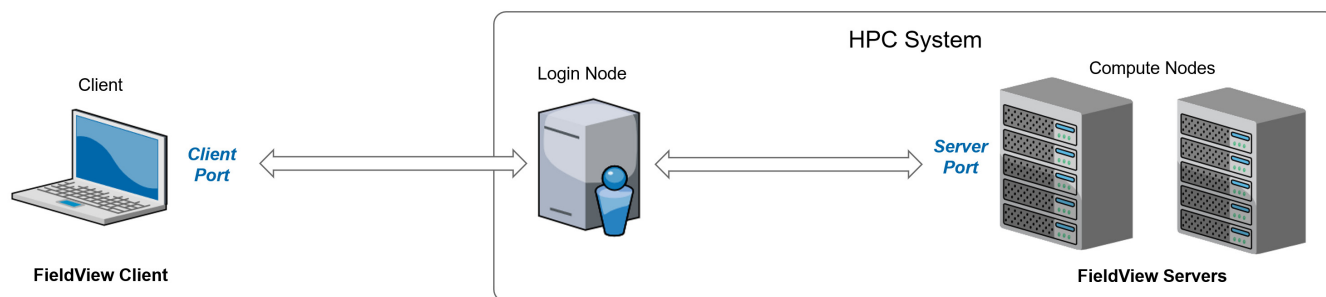


Figure 1 Client-Server mode to an HPC system.

FieldView provides several options for post-processing remote CFD results on HPC systems. If you want to run interactively and choose not to or cannot run FieldView remotely on a visualization node on your HPC, Client-Server provides a very good option. In short, the FieldView Client will be running on your local system (a laptop or a workstation), using local graphics hardware acceleration (GPU), it will connect to a FieldView Server running on the HPC, where the server reads the CFD results and computes the objects to be rendered. For full details on Client-Server Mode, (see [Running Client-Server Mode](#)) in the User's Guide.

Any scripts or restarts created at the Client will subsequently be fully supported for running either interactively or in batch mode, submitting your job to the scheduler and having the server(s) do all the "heavy lifting".

The FieldView Server can be launched manually, see ["Manual Server Startup" on page 34 of the Users Guide](#). But, for better usability, the preferred way of running Client-Server is to use the Automatic Server Start. This mode uses Server Configuration Files for capturing the information FieldView needs to start a Server process. Once Server Configuration Files have been created and read by FieldView at startup, they will appear in the Server Configuration field of the Data Input panel (see below).

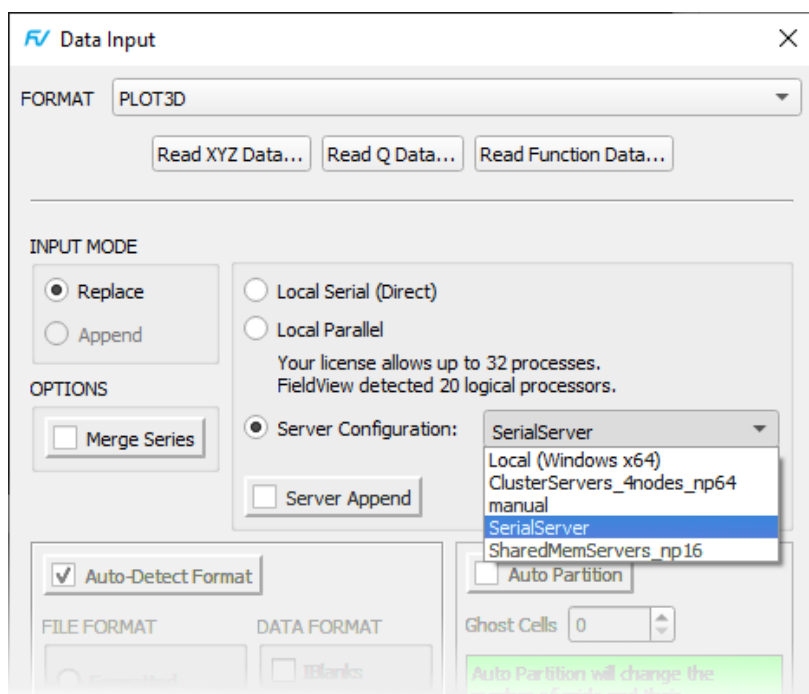


Figure 2 Server Configuration Field of the Data Input Panel

For full details on the Server Configuration Files, see [“Installing FieldView Servers on remote systems \(Optional\)” on page 13 of the Installation Guide](#). The rest of this section will focus on new capabilities that have been introduced with this version.

When selecting a Server Configuration with the Scheduler entry specified (see table below), FieldView will proceed with the following steps:

- A connection will be established by the FieldView Client to the system specified in the **ServerName** field (This is expected to be the Login Node on your HPC), using either SSH or plink, as specified in the **RemoteShell** field.



Note: it is required to have passwordless identification setup for SSH or plink (PuTTY) through Kerberos, a set of private and public keys, or any other means. This step will fail if passwordless identification hasn't been setup.

- A job request will be placed with the job scheduler specified in the **Scheduler** field (limited to PBS in this release.) If you use a different job scheduler, please let us know at support@tecplot.com, as our team will be working on adding support for more schedulers). This request is for a placeholder job named "FieldView". The goal of this job is to reserve resources on your Compute Nodes for the FieldView Server executables to run. For details on the job submission, see the full description below of the new fields in the Server Configuration file.

- The FieldView Client will monitor the status of the job submission until the job runs. While the job is in the queue, the user has an option to cancel the job submission by pressing the *Cancel Job* button, which will send an instruction to delete the job.
- When the job changes status and runs, the actual FieldView Server process(es) are started on the Compute Nodes and they connect back to the FieldView Client.
- The placeholder FieldView job will continue to run on the Compute Nodes until the FieldView Client is closed, or you have reached your job's *walltime* as set with the Server Configuration (.srv) file **JobTime**. If you replace or append a new CFD case, even if of a different input format, your existing Job will be used to read the data unless you select a different Server Configuration (.srv) file.



Note: communication from the Login Node to the Compute Nodes must be enabled through a remote shell without the need for a password.

The user will be able to follow FieldView's progress through these different steps thanks to messages being printed on the new Client/Server Connection panel (shown below).

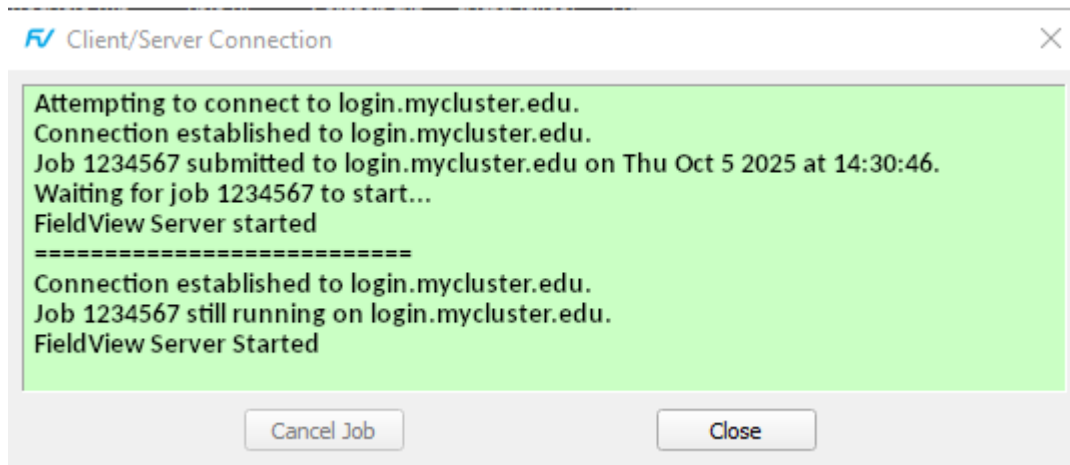


Figure 3 Client/Server Connection panel

Similar messages will be printed to the FieldView Console. More detailed information, including the details of your job submission and your remote shell commands can be shown to your console by setting the environment variable `FV_DEBUG_AUTOSTART=1` for the FieldView Client.

In addition, FieldView always saves the detailed information to file **FieldView_Autostart.log** in the following locations:

```
Windows: C:\Users\<username>\AppData\Local\Tecplot\fieldview
Linux: ~/.local/share/Tecplot\fieldview
Mac: ~/Library/Application Support/Tecplot\fieldview
```

The table below describes all the new fields added to the Server Configuration file. For a description of the rest of the fields, see [Table on page 20](#) of the Installation Guide.

Keyword	Meaning	Default Value
Scheduler:	Name of scheduler used, eg. PBS	none ; (Limited to PBS in this release) Note, if undefined, <i>AutoStart</i> : defaults to non-scheduler behavior.
Queue:	Name of the queue on which to launch the FV Server on the Compute Node	none ; Mandatory field, valid only if <i>Scheduler</i> : is defined.
JobTime:	Maximum time the job will run before being killed by the scheduler. Syntax: hh:mm:ss	none ; Mandatory field, valid only if <i>Scheduler</i> : is defined.
Allocation:	Project ID (string) for resource allocation on the HPC system towards which the job will be charged.	none ; Mandatory field, valid only if <i>Scheduler</i> : is defined.
NumNodes:	Number of Compute Nodes specified to run FieldView servers.	Defaults to 1. Valid only if <i>Scheduler</i> : is defined. A value of 1 runs shared memory servers, Values >1 runs servers in cluster configuration.
NumCpus:	Specification of the number of CPU cores your assigned node(s) should have. This is unrelated to NumProcs, which controls the number of Parallel FieldView Server processes.	ceil(NumProcs/NumNodes)
SchedulerOptions:	Additional job directives, eg. <i>SchedulerOptions: :bigmem</i> to request large memory compute nodes. Multiple arguments are allowed.	none ; Valid only if <i>Scheduler</i> : is defined. Note that options must be specified with leading ":" character as shown in the example at left.

Figure 4 New Server Configuration (.srv) file fields for automated Job Scheduling on HPC systems.

Example Server Configuration (.srv) files

Use of a scheduler for serial Client-Server - These specifications will result in the **qsub** command:

```
qsub -A ABCX230010020 -q debug -l walltime=00:30:00 -l select=1:ncpus=128:mpiprocs=1
```

```
Scheduler:      PBS
ServerName:     loginnode@mycluster
Allocation:     ABCX230010020
NumCpus:        128
NumNodes:       1
RemoteShell:    ssh
Queue:          debug
JobTime:        00:30:00
ServerDirectory: /home/user/programs/fv2023/fv/bin
```

Use of a scheduler for shared memory parallel Client-Server using 64 FieldView

Workers - This allows running all FieldView Server processes on a single Compute Node.

If your Compute Nodes have enough memory to load and process your CFD results, this will give you the best parallel performance. These specifications will result in the **qsub** command:

```
qsub -A ABCX230010020 -q debug -l walltime=00:30:00 -l select=1:ncpus=128:mpiprocs=64
```

```
Scheduler:      PBS
ServerName:     loginnode@mycluster
Allocation:     ABCX230010020
NumCpus:        128
NumNodes:       1
NumProcs:      64
RemoteShell:    ssh
Queue:          debug
JobTime:        00:30:00
ServerType:    shared_mem_parallel
ServerDirectory: /home/user/programs/fv2023/fv/bin
```

Use of a scheduler for cluster parallel Client-Server across Compute Nodes, again using 64 FieldView Workers - This allows using more memory overall and is useful if your HPC system has a limited amount of memory per node. But it will come at the cost of slower communication across processes. These specifications will result in the **qsub** command:

```
qsub -A ABCX230010020 -q debug -l walltime=00:30:00 -l select=4:ncpus=128:mpiprocs=64
```

```
Scheduler:      PBS
serverName:     loginnode@mycluster
Allocation:     ABCX230010020
NumCpus:        128
NumNodes:     4
NumProcs:       64
RemoteShell:    ssh
Queue:          debug
JobTime:        00:30:00
ServerType:   cluster_parallel
ServerDirectory: /home/user/programs/fv2023/fv/bin
```

Open MPI Upgrade

The version of Open MPI distributed with FieldView has been upgraded to Open MPI 4.1.5. This upgrade has greatly improved the portability of FieldView parallel on modern HPC systems. If you prefer to run with your own MPI [see “Replacing FieldView’s MPI \(Optional\)” on page 9 of the Installation Guide.](#)

New Capability - Show Surface Localized Min/Max

With FieldView 2023, a new feature is provided on the Surface Panels which allows you to turn on markers and annotation to identify the locations of the minimum and maximum values of a scalar quantity on a given surface.

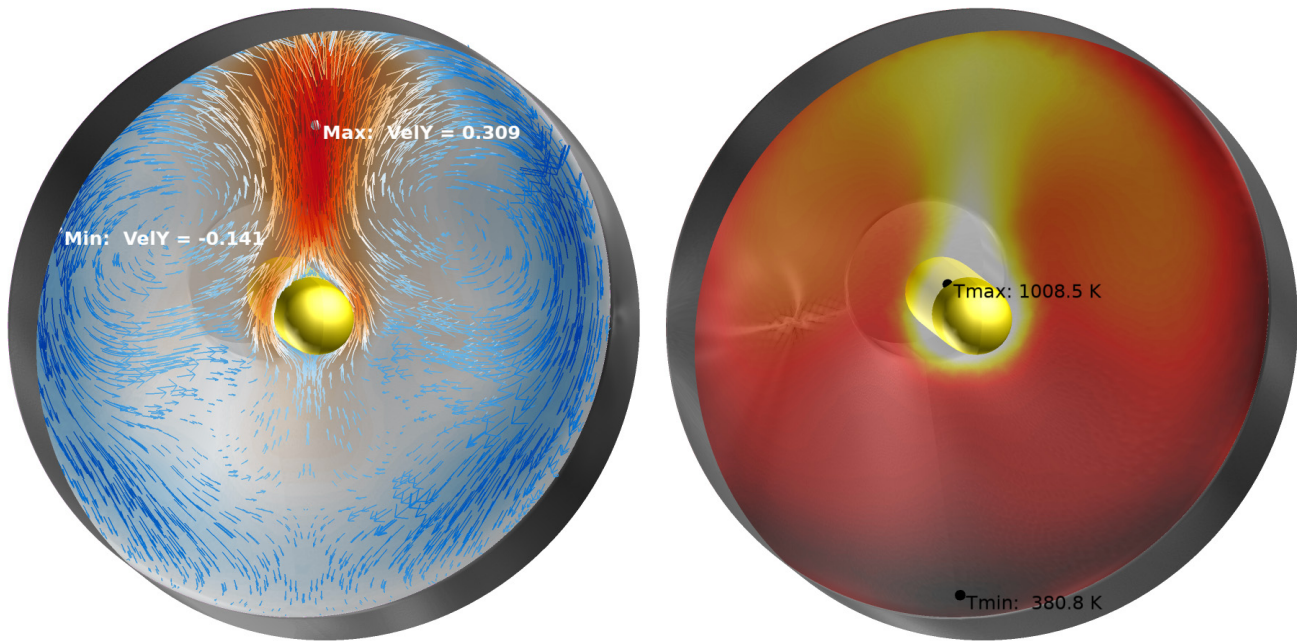


Figure 5 Locations of minimum and maximum values for two scalars. Note the different label settings used for each surface..

The following figure shows the new option *Scalar Min/Max* as it now appears on the Boundary Surface, Iso Surface, Computational Surface and Coordinate Surface panels. Turning the feature on will default to the values shown in the Options Panel.

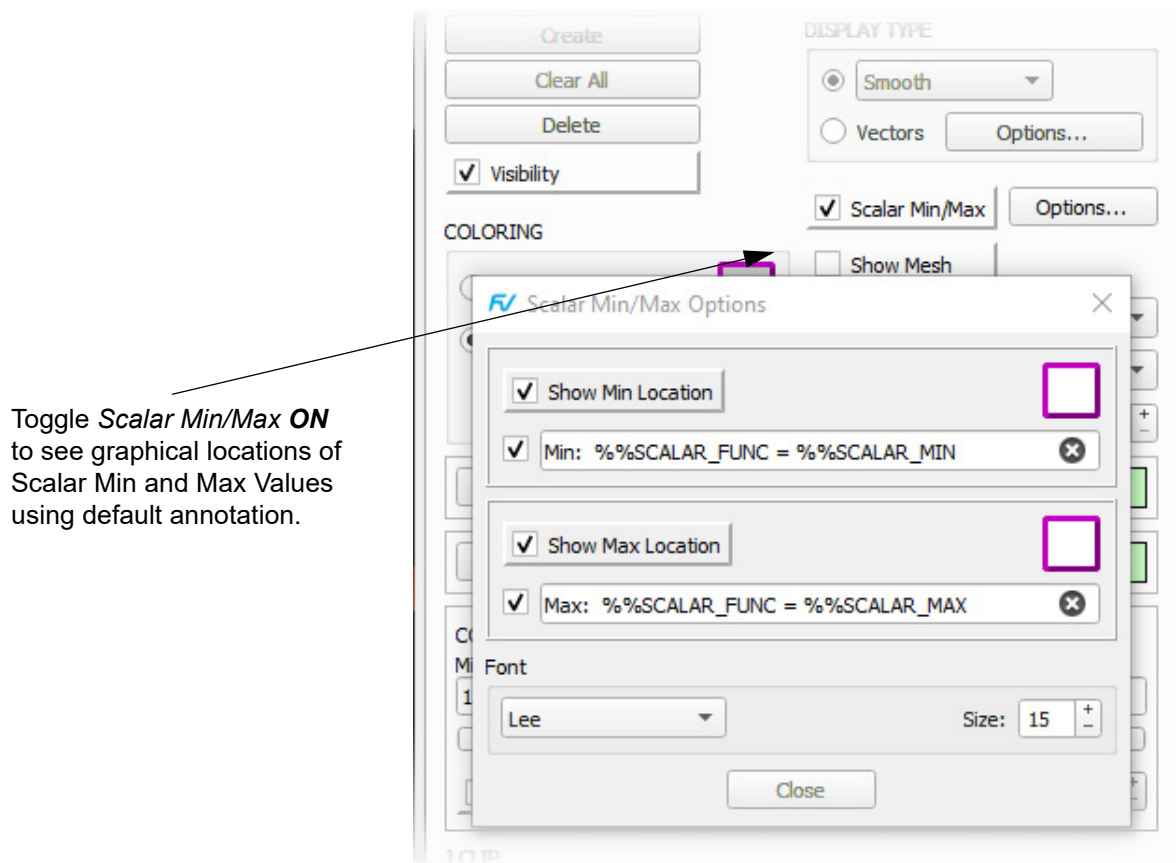


Figure 6 New Feature Scalar Min/Max, and corresponding Options Panel.

Show Min Location and Show Max Location can be activated independently to place markers at the respective locations on the current Surface. Annotation for your Min and Max locations can be set independently for each location. The default text uses escape sequences for your current scalar function and its respective value, but can be replaced with any text of your preference.

Numerical formatting escape sequences (to control the formatting of the reported %%SCALAR_MIN or %%SCALAR_MAX values) can be added as described in the section [Special Numerical Annotation \(Escape Sequences\)](#) of the *Working With FieldView* document. Note that as you hover (pass your mouse over) the annotation field, the following tool tip will be shown.

Annotation Escape Sequences supported:
 %%SCALAR_FUNC
 %%SCALAR_MIN
 %%SCALAR_MAX
 %%CURRENT

%%SCALAR_MIN, %%SCALAR_MAX, and %%CURRENT support the special numerical annotation escape sequences F#.# and E#.#

For an object with >1 min and/or minimum or maximum values, only a single location will be shown. For example, an X Coordinate surface clipped by Y will actually have min or max values along its edge, but only one location will be shown.

These settings can be used for FVX automation. The following FVX "chunk" shows the format:

```
scalar_minmax_options = {  
    min = {  
        show_location = "on",  
        color = "white",  
        text = "Min:  %%SCALAR_FUNC = %%SCALAR_MIN",  
        show_text = "on",  
    }, -- min  
    size = 25,  
    max = {  
        show_location = "on",  
        color = "white",  
        text = "Max:  %%SCALAR_FUNC = %%SCALAR_MAX",  
        show_text = "on",  
    }, -- max  
    font = "lee",  
}, -- scalar_minmax_options
```

New User Defined Function atan2

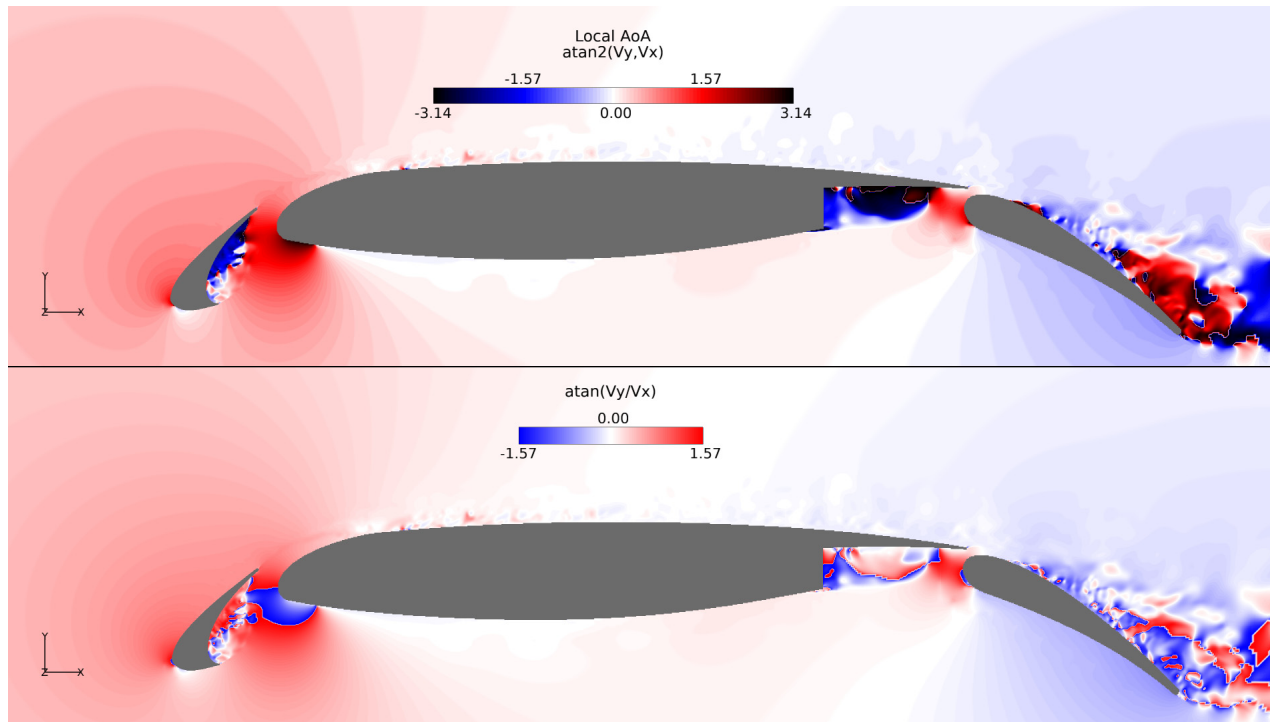


Figure 7 Use of the atan2 function to compute local angle of attack (AoA) - top view

Function atan2 is now supported for User Defined Formulas. It is the two-arguments arctangent function (as defined in C). $\text{atan2}(y, x)$ is the angle measure (in radians) between the positive x-axis and the ray from the origin to the point (x, y) in the Cartesian plane. Its range is $[-\pi; \pi]$.

The function atan2 is especially useful for computing local angle of attack based on a velocity field V . For a flow aligned with the x-axis in the XY plane, local angle of attack is obtained by computing $\text{atan2}(V_y, V_x)$.

In previous FieldView versions, only the arctangent function atan was available. Because of its $[-\pi/2; \pi/2]$ range, it was limited to small values of local angle of attack. The image below shows a comparison between the two functions.

A new atan2 button has been added to the Function Formula Specification panel.

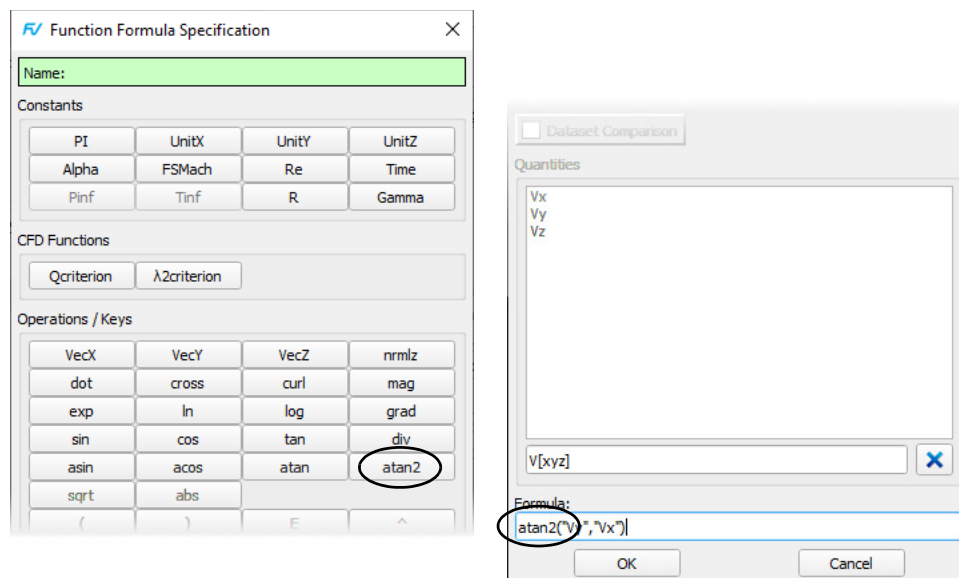


Figure 8 Creating a formula using filter V[xyz] in the name filter field to select input for the atan2() function. (Function Formula Specification panel is split for clarity.)

New Display Option Polyspheres for Particle Paths

Previously, only Display Type *Spheres* was available. This Display Type uses a computer graphics technique which provides good performance for up to millions of spheres. But the intersection between these spheres and other objects in the scene can only be approximated, leading to unphysical intersection patterns, as shown in the image below on the left. This problem is particularly annoying when using Particle Paths to render the locations and values of experimental measurements such as pressure probe, in conjunction with CFD results.

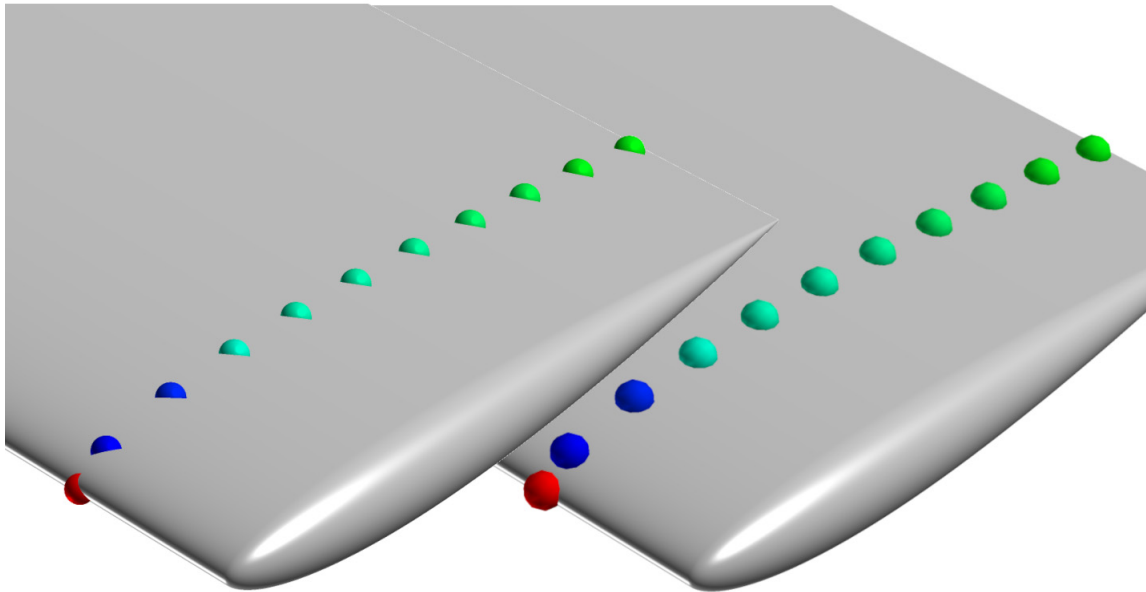


Figure 9 Compared views of Display Types Spheres (left) and Polyspheres (right). Note the more accurate intersection with the surface when Polyspheres is being used.

With the new Display Type Polyspheres, an accurate intersection with surfaces can be obtained. Note, however, that Polyspheres is several times slower to render than Spheres. It should only be used when the number of particles is low.

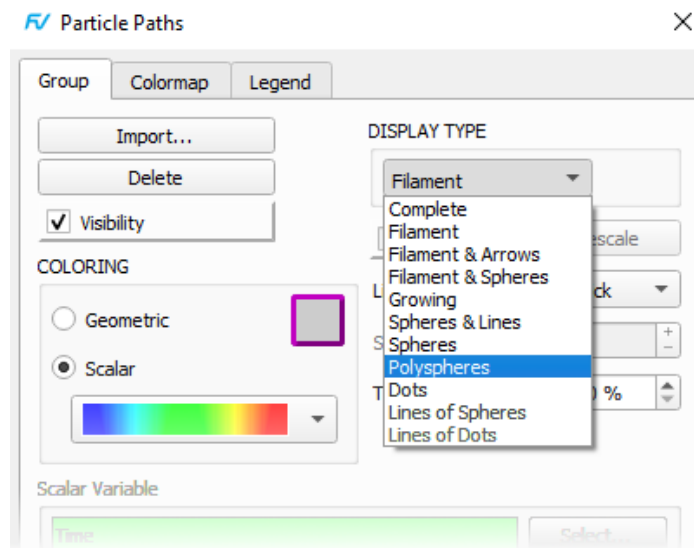


Figure 10 Polyspheres Display Type as shown on Particles Path Panel

The Polysphere display type is also supported within FVX scripts, and with restarts. For FVX, there is a new option for `display_type`, as shown in this code snippet:

```
set_streamlines_display ({display_type = "polyspheres"})
```

The VTK reader has been largely improved in FieldView 2023.

Support for vtkImageData VTI files

FieldView's VTK reader now supports vtkImageData. This format is used to store a topological and geometrical regular array of points, often called "voxels". It can be used as an output format by some CFD solvers, such as the ones used for solving the cartesian off-body discretization by CREATE-AV solvers Helios and Kestrel. Extensions .vti, or .pvti when multiple VTI files are grouped, are typically used for this format. The latter is compatible with a parallel read.

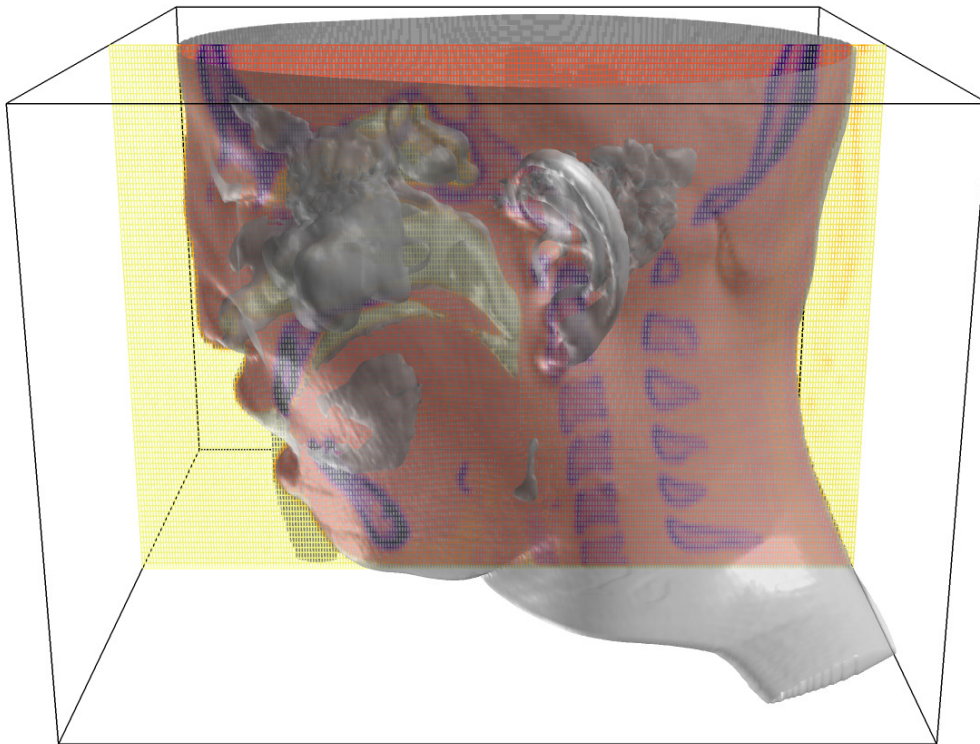


Figure 11 example VTI dataset read in FieldView with the extended VTK reader.

The preferred option for reading VTI data is to use the "VTK Structured" reader. The structured nature of the data will be maintained allowing the creation of Computational Surfaces. Internal optimizations in FieldView will also be used to make the read process and most further operations both fast and memory efficient.

When VTI data is mixed with other VTK formats in a .vtm file, including unstructured data, then the "VTK Unstructured" reader must be used. In that case, VTI data will be converted to unstructured on the fly, during the read operation.

Support for IBlanking information in VTU datasets

IBlanking information is stored in the unstructured VTU format in the form of a field called `vtkGhostType`. When present, this field is now loaded as a scalar. FieldView does not have support for IBlanking in unstructured datasets. But with `vtkGhostType` being loaded as a scalar field, it can be used for thresholding objects as seen in the image below.

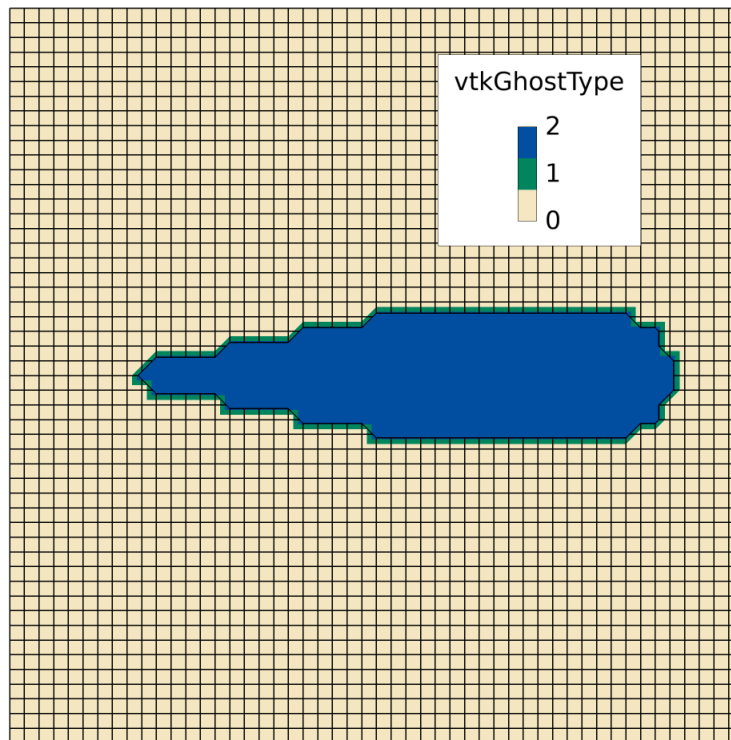


Figure 12 field `vtkGhostType` being read from an example VTU dataset and being used for thresholding the mesh

Improved Transient Capabilities for Data with Changing Grid Counts

For a transient dataset given as a series of files (aka. Transient Set), FieldView will prompt you to read the whole series of files and treat them as a transient dataset. Readers which cannot determine whether your grids use *Adaptive Mesh Refinement* (AMR) will provide the additional checkbox so that you can allow FieldView to read them as such.

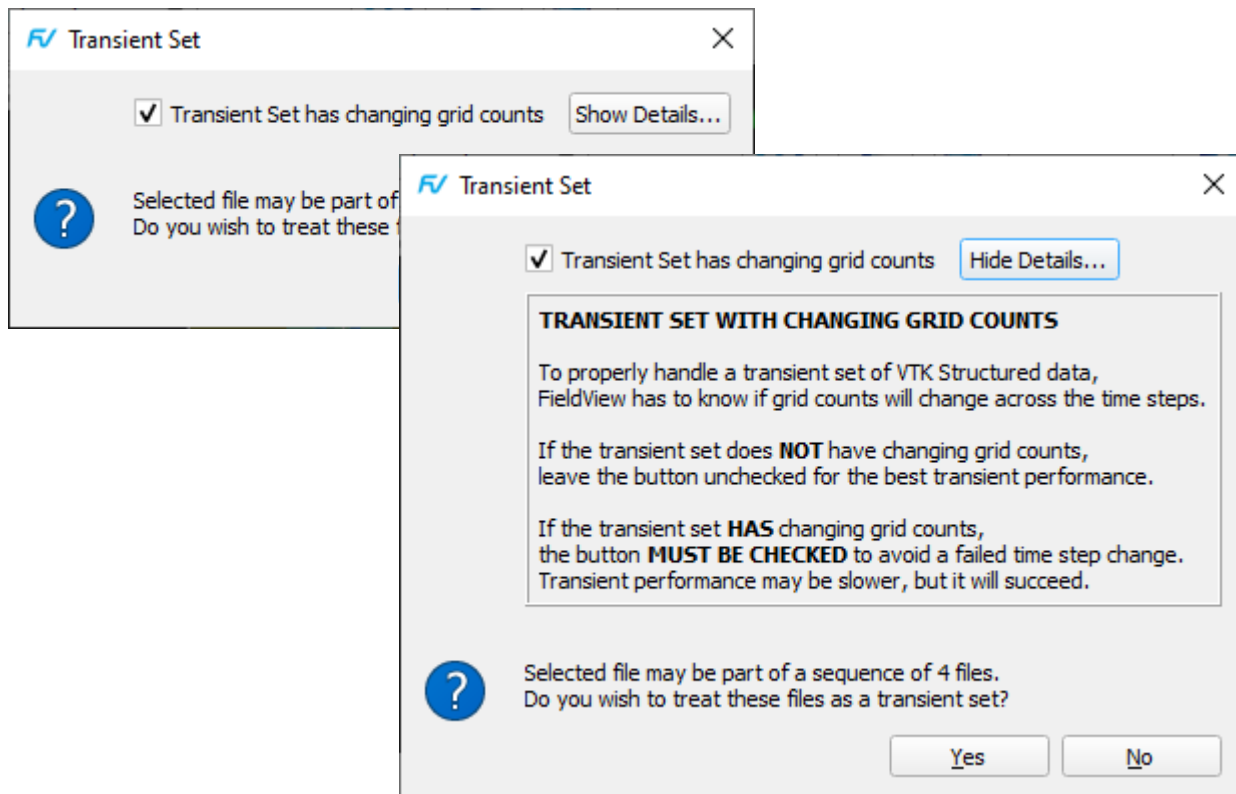


Figure 13 Transient Set panel with option for *changing grid count* data, and Details panel.

The following behaviors will remain unchanged.

Readers where transient information is contained within a single file (eg. FLOW-3D and Open-FOAM) will produce a prompt allowing you to select your initial timestep.

Readers PLOT3D, OVERFLOW-2 can detect changing grid counts, and if detected, an additional prompt will appear: "Your dataset has changing grid counts across time steps. Computational surfaces will not be preserved during a transient sweep. Do you wish to continue?". If the prompt is not accepted, your data will be read as steady.

For FVUNS and XDB data, changing grids are handled without user intervention.

Tecplot 360 and Ensight readers are more visible

FieldView's *Generic Unstructured* reader has been replaced and now provides two new input options, *Tecplot 360* and *Ensignt*. Each has its own file filters - *.plt* extensions for Tecplot 360 files, and either *.case* or *.encas* extensions for Ensight files.

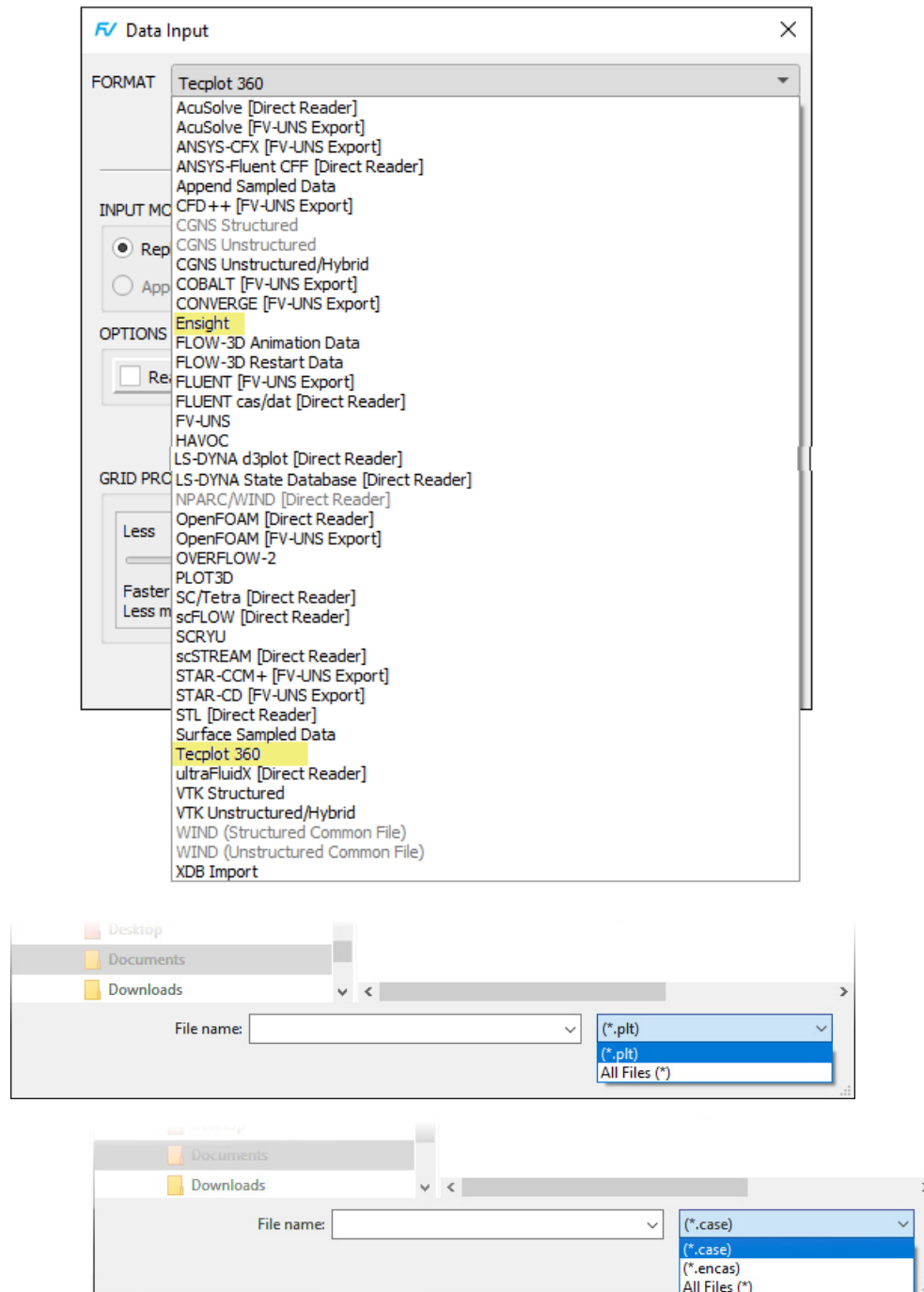


Figure 14 Tecplot 360 and Ensight Data Input options and their respective file filters.

Restarts and scripts saved or written with earlier FieldView releases will remain backward compatible, and the FVX data_format field *generic_unstructured* has been deprecated. The below figure shows simplified example input tables for the FVX function *read_dataset()* for each of these readers.

Tecplot 360 example:

```
data_input_table = {
    data_format = "tecplot_360",
    input_parameters = {
        name = "/home/user/data/hl1_a21p24.plt",
        options = options_table,
    } -- input_parameters
}
read_dataset(data_input_table
```

Ensight example:

```
data_input_table = {
    data_format = "ensight",
    input_parameters = {
        name = "/home/user/data/cyl_shed.1.encas",
        options = options_table,
    } -- input_parameters
}
read_dataset(data_input_table
```

Figure 15 FVX examples for *Tecplot 360* and *Ensight* data input

Other Important New Features

- FieldView for Windows now accepts datasets up to the 100K limit and parallel performance has been greatly improved when post processing data with high grid counts on Windows systems.
- Similar to other applications, FieldView will now create a *Desktop Shortcut* when installed on Windows. This was a request from several of our Users.
- As FieldView is installed (on any platform), users must now accept Tecplot's EULA (End User License Agreement), as is customary for any software.
- The ANSYS Fluent CFF reader has been updated to read the latest CFF files from ANSYS Fluent.

List of Resolved Issues

- An issue with multi-threading where FieldView would sometimes crash when using the curl() function has been fixed.
- A problem with licensing, where running remote servers to a Linux or macOS client would improperly be rejected has been fixed.
- A problem trying to read a case in parallel would sometimes fail with message "Data reader does not support parallel operation" was fixed.
- A problem where reading a case of exactly 50K or 100K grids would fail with error has been fixed.
- On macOS, Tools > FVX Utilities which could not function without Tcl support have been removed from the menu.
- Work has been done on the PLOT3D and OVERFLOW-2 readers so that automatic byte swapping will succeed for datasets with over 65K grids, and the read will now succeed.
- A performance problem with Computational Surfaces when using data with a large number of grids has been fixed.
- A problem where local scalar min/max was not being properly updated for Dynamically Clipped visualization objects has been fixed.
- We have updated FieldView's version of OpenSSL to address a published vulnerability issue.
- We have updated FieldView's VTK library, eliminating warning messages.
- We have addressed two problems with using PFPR (Partitioned File Parallel Reader) for PLOT3D and OVERFLOW-2 cases.
- A problem with FieldView was erroneously detecting a changing grid count which limited transient functionality was addressed.

- A problem where transient time step changes were losing information about grid subset settings (grids, or IJK ranges) was getting lost has been fixed
- A problem with exceeding the allowable partition count-per-worker of 1342 in PFPR (Partitioned File Parallel Reader) input data has been fixed.
- A problem with creating 3DPDF files on macOS has been fixed.
- A problem with setting antialiasing on or off effecting font sizes for ruled grids has been addressed.
- The ability to clip a Computational Surface to a mesh line when Mesh display type is being used has been restored.
- A problem has been addressed that was causing the Data Input panel to browse for files locally (Client side) although a Server read was selected.
- An issue has been addressed which could cause FieldView to hang when performing a transient sweep when using software graphics.
- The Cutting Plane definition process has been optimized to avoid recomputing the plane unnecessarily.