Ansys 2021 R2
Engineering What's Ahead.

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Ansys Fluent User's Guide

Ansys
ANSYS, Inc.
Southpointe
2600 Ansys Drive
Canonsburg, PA 15317
ansysinfo@ansys.com
http://www.ansys.com
(T) 724-746-3304
(F) 724-514-9494

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Part I: Getting Started

The section describes getting started with Ansys Fluent.

- Introduction to Ansys Fluent (p. 129), introduction to Ansys Fluent.
- Basic Steps for CFD Analysis using Ansys Fluent (p. 155), basic steps for CFD analysis using Ansys Fluent.
- Guide to a Successful Simulation Using Ansys Fluent (p. 161), guide to a successful simulation using Ansys Fluent.
- Starting and Executing Ansys Fluent (p. 163), provides instructions for starting and executing Ansys Fluent.
- Glossary of Terms (p. 193), this glossary contains a listing of terms commonly used throughout the Ansys Fluent documentation.

Chapter 1: Introduction to Ansys Fluent

Ansys Fluent is a state-of-the-art computer program for modeling fluid flow, heat transfer, and chemical reactions in complex geometries.

Ansys Fluent is written in the C computer language and makes full use of the flexibility and power offered by the language. Consequently, true dynamic memory allocation, efficient data structures, and flexible solver control are all possible. In addition, Ansys Fluent uses a client/server architecture, which enables it to run as separate simultaneous processes on client desktop workstations and powerful compute servers. This architecture allows for efficient execution, interactive control, and complete flexibility between different types of machines or operating systems.

Ansys Fluent provides complete mesh flexibility, including the ability to solve your flow problems using unstructured meshes that can be generated about complex geometries with relative ease. Supported mesh types include 2D triangular/quadrilateral, 3D tetrahedral/hexahedral/pyramid/wedge/polyhedral, and mixed (hybrid) meshes. Ansys Fluent also enables you to refine or coarsen your mesh based on the flow solution.

You can read your mesh into Ansys Fluent, or, for 3D geometries, create your mesh using the meshing mode of Fluent (see the Fluent User's Guide (p. 1) for further details). All remaining operations are performed within the solution mode of Fluent, including setting boundary conditions, defining fluid properties, executing the solution, refining the mesh, and postprocessing and viewing the results.

The Ansys Fluent serial solver manages file input and output, data storage, and flow field calculations using a single solver process on a single computer. Ansys Fluent also uses a utility called `cortex` that manages Ansys Fluent's user interface and basic graphical functions. Ansys Fluent's parallel solver enables you to compute a solution using multiple processes that may be executing on the same computer, or on different computers in a network.

The Ansys Fluent solver manages file input and output, data storage, and flow field calculations. Processing involves an interaction between Ansys Fluent, a host process, and one or more compute-node processes. Ansys Fluent interacts with the host process and the compute node(s) using a utility called `cortex`, which manages Ansys Fluent's user interface and basic graphical functions.

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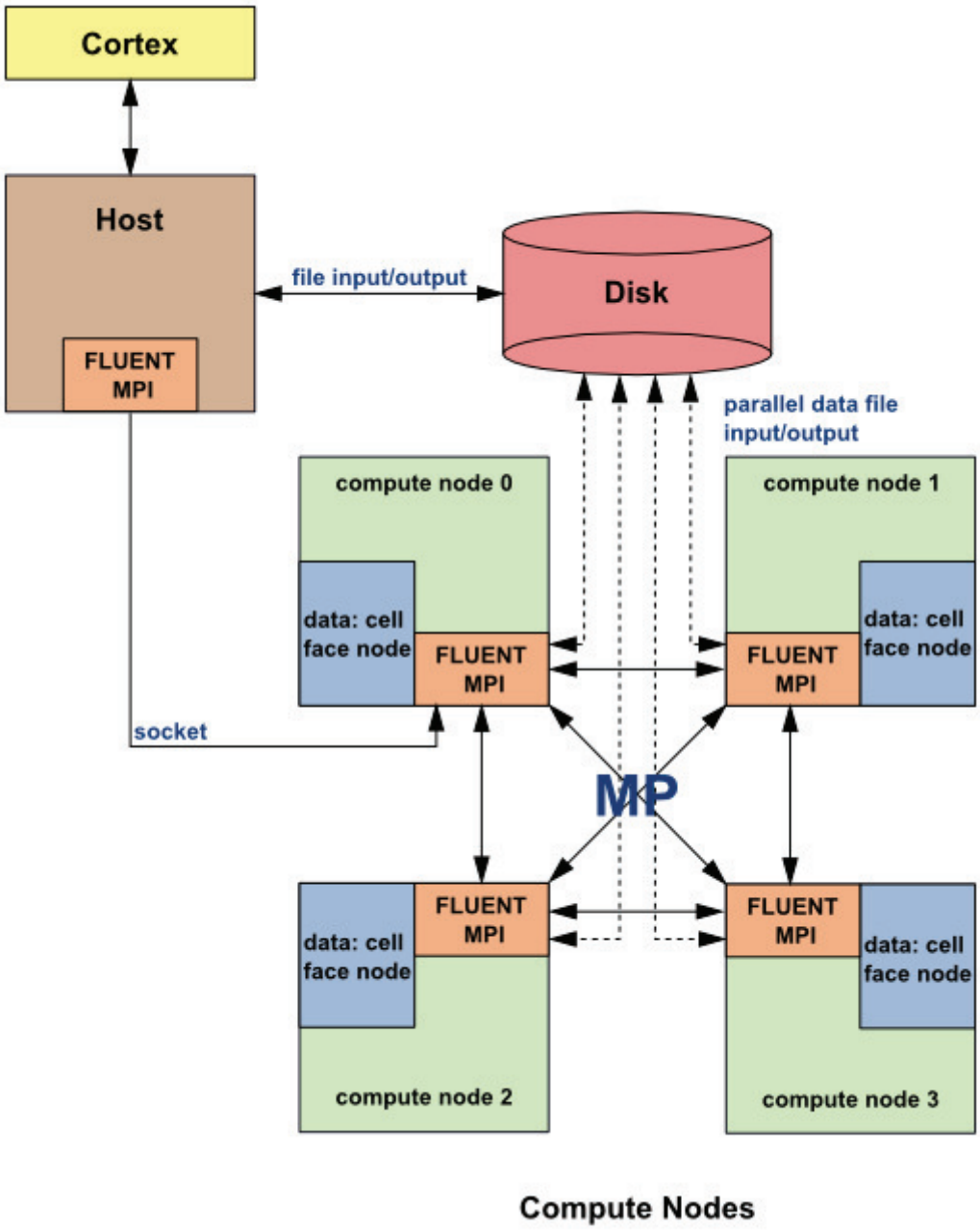
Figure 1.1: Ansys Fluent Architecture



Ansys Fluent's serial solver uses a single compute node, whereas the parallel solver computes a solution using multiple compute nodes that may be executing on the same computer, or on different computers in a network.

For more information about Ansys Fluent's parallel processing capabilities, message passing interfaces (MPI), and so on, refer to Parallel Processing (p. 3745) in the User's Guide (p. 1).

All functions required to compute a solution and display the results are accessible in Ansys Fluent through an interactive interface.

For more information, see the following sections:

1.1. The Ansys Product Improvement Program

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1.2. Program Capabilities
1.3. Known Limitations in Ansys Fluent 2021 R2

1.1. The Ansys Product Improvement Program

This product is covered by the Ansys Product Improvement Program, which enables Ansys, Inc., to collect and analyze *anonymous* usage data reported by our software without affecting your work or product performance. Analyzing product usage data helps us to understand customer usage trends and patterns, interests, and quality or performance issues. The data enable us to develop or enhance product features that better address your needs.

How to Participate

The program is voluntary. To participate, select **Yes** when the Product Improvement Program dialog appears. Only then will collection of data for this product begin.

How the Program Works

After you agree to participate, the product collects anonymous usage data during each session. When you end the session, the collected data is sent to a secure server accessible only to authorized Ansys employees. After Ansys receives the data, various statistical measures such as distributions, counts, means, medians, modes, etc., are used to understand and analyze the data.

Data We Collect

The data we collect under the Ansys Product Improvement Program are limited. The types and amounts of collected data vary from product to product. Typically, the data fall into the categories listed here:

Hardware: Information about the hardware on which the product is running, such as the:

- brand and type of CPU
- number of processors available
- amount of memory available
- brand and type of graphics card

System: Configuration information about the system the product is running on, such as the:

- operating system and version
- country code
- time zone
- language used
- values of environment variables used by the product

Session: Characteristics of the session, such as the:

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- interactive or batch setting
- time duration
- total CPU time used
- product license and license settings being used
- product version and build identifiers
- command line options used
- number of processors used
- amount of memory used
- errors and warnings issued

Session Actions: Counts of certain user actions during a session, such as the number of:

- project saves
- restarts
- meshing, solving, postprocessing, etc., actions
- times the Help system is used
- times wizards are used
- toolbar selections

Model: Statistics of the model used in the simulation, such as the:

- number and types of entities used, such as nodes, elements, cells, surfaces, primitives, etc.
- number of material types, loading types, boundary conditions, species, etc.
- number and types of coordinate systems used
- system of units used
- dimensionality (1-D, 2-D, 3-D)

Analysis: Characteristics of the analysis, such as the:

- physics types used
- linear and nonlinear behaviors
- time and frequency domains (static, steady-state, transient, modal, harmonic, etc.)
- analysis options used

Solution: Characteristics of the solution performed, including:

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- the choice of solvers and solver options
- the solution controls used, such as convergence criteria, precision settings, and tuning options
- solver statistics such as the number of equations, number of load steps, number of design points, etc.

Specialty: Special options or features used, such as:

- user-provided plug-ins and routines
- coupling of analyses with other Ansys products

Data We Do Not Collect

The Product Improvement Program does *not* collect any information that can identify you personally, your company, or your intellectual property. This includes, but is not limited to:

- names, addresses, or usernames
- file names, part names, or other user-supplied labels
- geometry- or design-specific inputs, such as coordinate values or locations, thicknesses, or other dimensional values
- actual values of material properties, loadings, or any other real-valued user-supplied data

In addition to collecting only anonymous data, we make no record of where we collect data from. We therefore cannot associate collected data with any specific customer, company, or location.

Opting Out of the Program

You may *stop* your participation in the program any time you wish. To do so, select **Ansys Product Improvement Program** from the Help menu. A dialog appears and asks if you want to continue participating in the program. Select **No** and then click **OK**. Data will no longer be collected or sent.

The Ansys, Inc., Privacy Policy

All Ansys products are covered by the Ansys, Inc., Privacy Policy.

Frequently Asked Questions

1. *Am I required to participate in this program?*

   No, your participation is voluntary. We encourage you to participate, however, as it helps us create products that will better meet your future needs.

2. *Am I automatically enrolled in this program?*

   No. You are not enrolled unless you explicitly agree to participate.

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3. *Does participating in this program put my intellectual property at risk of being collected or discovered by Ansys?*

   No. We do not collect any project-specific, company-specific, or model-specific information.

4. *Can I stop participating even after I agree to participate?*

   Yes, you can stop participating at any time. To do so, select **Ansys Product Improvement Program** from the Help menu. A dialog appears and asks if you want to continue participating in the program. Select **No** and then click **OK**. Data will no longer be collected or sent.

5. *Will participation in the program slow the performance of the product?*

   No, the data collection does not affect the product performance in any significant way. The amount of data collected is very small.

6. *How frequently is data collected and sent to Ansys servers?*

   The data is collected during each use session of the product. The collected data is sent to a secure server once per session, when you exit the product.

7. *Is this program available in all Ansys products?*

   Not at this time, although we are adding it to more of our products at each release. The program is available in a product only if this *Ansys Product Improvement Program* description appears in the product documentation, as it does here for this product.

8. *If I enroll in the program for this product, am I automatically enrolled in the program for the other Ansys products I use on the same machine?*

   Yes. Your enrollment choice applies to all Ansys products you use on the same machine. Similarly, if you end your enrollment in the program for one product, you end your enrollment for all Ansys products on that machine.

9. *How is enrollment in the Product Improvement Program determined if I use Ansys products in a cluster?*

   In a cluster configuration, the Product Improvement Program enrollment is determined by the host machine setting.

10. *Can I easily opt out of the Product Improvement Program for all clients in my network installation?*

    Yes. Perform the following steps on the file server:

    a. Navigate to the installation directory: `[Drive:]\v212\commonfiles\globalsettings`

    b. Open the file **ANSYSProductImprovementProgram.txt**.

    c. Change the value from "on" to "off" and save the file.

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1.2. Program Capabilities

When in meshing mode, Ansys Fluent functions as a robust unstructured-volume-mesh generator (see Meshing Mode Capabilities (p. 199) in the Fluent User's Guide (p. 1) for further details). When in solution mode, Fluent allows you to simulate the following:

- 2D planar, 2D axisymmetric, 2D axisymmetric with swirl (rotationally symmetric), and 3D flows
- Flows on quadrilateral, triangular, hexahedral (brick), tetrahedral, wedge, pyramid, polyhedral, and mixed element meshes
- Steady-state or transient flows
- Incompressible or compressible flows, including all speed regimes (low subsonic, transonic, supersonic, and hypersonic flows)
- Inviscid, laminar, and turbulent flows
- Newtonian or non-Newtonian flows
- Ideal or real gases
- Heat transfer, including forced, natural, and mixed convection, conjugate (solid/fluid) heat transfer, and radiation
- Chemical species mixing and reaction, including homogeneous and heterogeneous combustion models and surface deposition/reaction models
- Free surface and multiphase models for gas-liquid, gas-solid, and liquid-solid flows
- Lagrangian trajectory calculations for dispersed phase (particles/droplets/bubbles), including coupling with continuous phase and spray modeling
- Cavitation model simulations
- Melting/solidification applications using the phase change model
- Porous media with non-isotropic permeability, inertial resistance, solid heat conduction, and porous-face pressure jump conditions
- Lumped parameter models for fans, pumps, radiators, and heat exchangers
- Acoustic models for predicting flow-induced noise
- Inertial (stationary) or non-inertial (rotating or accelerating) reference frames
- Multiple moving frames using multiple reference frame (MRF) and sliding mesh options
- Mixing-plane model simulations of rotor-stator interactions, torque converters, and similar turbomachinery applications with options for mass conservation and swirl conservation
- Dynamic mesh model simulations for domains with moving and deforming meshes
- Volumetric sources of mass, momentum, heat, and chemical species

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- Simulations that use a material property database
- Simulations in which the design is revised or optimized, using the adjoint solver or the mesh morpher/optimizer
- Simulations customized by user-defined functions
- Dynamic (two-way) coupling with GT-POWER and WAVE
- Simulations that use the following add-on modules:
  - Battery module
  - Continuous fiber module
  - Macroscopic particle model (MPM) module
  - Fuel cell modules
  - Magnetohydrodynamics (MHD) module
  - Population balance module
- Fluent as a Server (documented separately)
- Fluent Icing

Ansys Fluent is available at three different licensing levels, which control the availability of the above-mentioned features and functionalities:

- **Enterprise**—full access to all Fluent Meshing and Fluent solver capabilities, as documented in the Fluent User's Guide. Additionally, this licensing level provides access to Ansys EnSight, Polyflow, Ansys FENSAP-ICE, the Model Fuel Library, and the Fluent workspaces.
- **Premium**—full access to all Fluent Meshing and Fluent solver capabilities, as documented in the Fluent User's Guide.
- **Pro**—access to the Water-Tight Meshing workflow in Fluent Meshing and access to a reduced set of Fluent solver capabilities allowing the solution of incompressible and compressible steady-state, single-phase, turbulent, non-reacting flows, and heat transfer. See Ansys Capability Chart 2021 R2 for a comprehensive list of supported functionalities at the CFD-Pro licensing level. *Note that only supported options and functionalities are displayed in the interface.*

Ansys Fluent is ideally suited for incompressible and compressible fluid-flow simulations in complex geometries. Ansys Fluent's parallel solver enables you to compute solutions for cases with very large meshes on multiple processors, either on the same computer or on different computers in a network. Ansys, Inc. also offers other solvers that address different flow regimes and incorporate alternative physical models. Additional CFD programs from Ansys, Inc. include CFX, Ansys Icepak, and Ansys Polyflow.

1.3. Known Limitations in Ansys Fluent 2021 R2

This section lists limitations that are known to exist in Ansys Fluent. Where possible, suggested work-arounds are provided.

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- Graphical User Interface

  – (Linux only) Ansys Fluent does not support AMD Radeon Pro graphics cards and the Fluent session may close unexpectedly. (348500)

  – Dragging the Ansys Fluent application between 4K and non-4K displays may result in the application not scaling correctly. As a workaround, restart Ansys Fluent after relocating it to a new screen to make it appear as expected. (345352)

  – Ansys Fluent may hang unexpectedly if you have a non-default layout, such as tabbing the console and the graphics window, and you force the MSW graphics driver, either by using `HOOPS_PICTURE=msw/win` or by launching with the `-driver msw` option. (269471)

  – (Windows on 4K monitors) You may need to adjust your display scaling and layout settings to optimize the fit of the Fluent application on your monitor.

  – (Linux Only) Automatic scaling of the Ansys Fluent application window and graphics window interactivity are not compatible when viewed on a 4K monitor. If the application is scaled properly, interactions in the graphics window may not behave as expected. Set `QT_AUTO_SCREEN_SCALE_FACTOR` equal to `1` to have the application scale properly. (143229)

- File import/export (for a list of supported files, refer to the table in this section, under **Third-party software**)

  – You cannot read a default CFF case file (.cas.h5) when creating a **bounded-by-surfaces** design condition (as part of the adjoint design tool) or when creating an imprinted surface. **Workaround**: Legacy case files (`.cas`) can be read in these circumstances, so you can save your `.cas.h5` file as a `.cas` file by opening it in a Fluent session and disabling the writing of CFF files (by entering the following text command: `file/cff-files? no`). (199821)

  – (Windows only) You cannot export files larger than 2GB to CGNS format. As a workaround, use a Linux machine to export files larger than 2GB to CGNS format. (259220)

  – Surfaces exported to EnSight format may contain a surface with an ID of zero. This is OK for importing into EnSight, but it will cause an error if you are importing into a non-Ansys third-party post-processing software, such as Paraview. As a workaround, create a zone surface for the surface with an ID of zero and export the newly created surface instead of the original. (254966)

  – `CGNS` files exported from TurboGrid 2019 R3 cannot be read into Ansys Fluent unless the **Split Blade Faces By Geometry** option is disabled in TurboGrid before you export the `CGNS` files. You can disable this option in TurboGrid by right-clicking **3D Mesh** in the **Mesh** tab, selecting **Edit in Command Editor** and setting **Split Blade Faces By Geometry** to **false**. (121053)

  – If you change the **File Storage Options** settings in the **Autosave** dialog box, the solution history will be lost.

  – When exporting EnSight Case Gold files for transient simulations, the solver cannot be switched between serial and parallel, and the number of compute nodes cannot be changed for a given parallel run. Otherwise, the exported EnSight Case Gold files for each time step will not be compatible.

  – EnSight export with topology changes is not supported.

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  - To properly view Fieldview Unstructured (`.fvuns`) results from a serial or parallel Ansys Fluent simulation:

    → Mesh files must be exported using the `fieldview-unstruct-grid` text command.

    → Mesh and data files should all be exported from parallel Ansys Fluent sessions with the same number of nodes.

  - Tecplot file import does not support the Tecplot360 file format.

  - The maximum number of profiles that can be read into a single Fluent session is 50.

  - The PARALLEL INDEPENDENT mode for Common Fluids File (CFF) file I/O is known to exhibit slow write performance. On parallel file systems, consider using the PARALLEL COLLECTIVE mode when writing CFF files. On other network file systems, consider using the HOST or NODE0 mode.

  - If you are accessing a file using a Universal Naming Convention (UNC) path, you must ensure that you have permission to access to all of the folders in the path or you will not be able to open the file.

  - (Windows only) The file filter available in the **Select File** dialog box may not work as expected, requiring you to manually select the desired file(s) without filtering aid. (174291)

  - Files written by Ansys products do not support synchronization with Microsoft's OneDrive file hosting service. (187717 / 74067)

- Mesh

  - If your license preferences are set to **Share a single license between applications when possible** (under **Tools**>**License Preferences**...) and you have a Fluent Meshing session open, then you open the Fluent Solution workspace, Fluent Meshing hangs without a chance for you to save your session. As a workaround, change your license preference to **Use a separate license for each application**, which will prevent you from opening another Fluent session if there is already one open. (147834)

  - Hover-over highlighting and Boundary Markers are not available in Meshing Mode. (241447)

  - Boundary zone extrusion is not possible from faces that have hanging nodes.

  - For simulations that involve the Fluent, Mechanical, and Meshing applications, meshing problems can arise in instances where there are multiple regions and contacts between them. In Fluent, a zone can only exist in a single contact region. The Mechanical and Meshing applications both use a different approach concerning contact regions when compared to Fluent.

  - Ansys Fluent does not support FSI data mapping of edges and, therefore, it is not supported in 2D.

  - At non-conformal interfaces, the **Matching** option is no longer allowed with the **Mapped** option. When opening a case set up in a previous release with both options enabled, you will be prompted to recreate the interface without the **Matching** option.

  - If your mesh topology has a step-wise prism mesh near the walls, do not use node-based gradients with MUSCL.

- Models

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– Mass-Weighted Average report definitions are not supported for reduced order models because the ROM only has data available on cell face centers and cell centers. Instead, use Area-Weighted Average, Facet Average, Facet Minimum, or Facet Maximum report definitions. (281540)

– The physical velocity porous formulation may produce non-physical flow fields and poor convergence when porous resistance (Inertial or Viscous) values are less than or comparable to the change in the dynamic pressure across the porous interface (interior face zone separating the porous and non-porous cell zone). Switching the porous interface zone to a porous jump boundary is an effective way to overcome this issue. (61773)

– Ansys Fluent supports the Chemkin II format for Oppdif flamelet import only.

– The surface-to-surface (S2S) radiation model does not work with moving/deforming meshes.

– The DPM work pile algorithm is not compatible with the wall film boundary condition.

– For transient Lagrangian multiphase analysis with DPM unsteady particle tracking, atomizer or cone injections will release particles from the same position rather than from random positions in one of the following cases:

  → **Particle Time Step Size** (set in the **Discrete Phase Model** dialog box) is smaller than **Time Step Size** (set in the **Run Calculation** task page)

  → Re-randomization of the initial particle positions from iteration to iteration is disabled using the following text command:

  ```
  define/models/dpm/numerics/re-randomize-every-iteration? [yes] no
  ```

  To use random starting points for the particles, enter the following scheme commands in the Ansys Fluent console:

  ```
  (rpsetvar 'dpm/random/seed-timestep-corrected? #t)

  (dpm-parameters-changed)
  ```

  Note that this change will also affect particle trajectories if stochastic tracking, particle breakup, or other mechanisms that involve random numbers are used. (176638)

– The shell conduction model is not applicable on moving walls.

– The heat exchanger model is not compatible with mesh adaption.

– The Fluent/Ansys Reaction Design KINetics coupling is not available on the win64 platform.

– DO-Energy coupling is recommended for large optical thickness cases (> 10) only.

– FMG initialization is not available with the shell conduction model.

– FMG initialization is not compatible with the unsteady solver.

– The MHD module is not compatible with Eulerian multiphase models.

– Bounded 2nd order discretization in time is not compatible with moving and deforming meshes.

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  - When simulating porous media, the value of the **Porosity** (defined in the **Fluid** dialog box) cannot be `0` or `1` (that is, it must be in between these values) if the non-equilibrium thermal model is enabled.

  - When simulating porous media, the non-equilibrium thermal model is not supported with radiation and/or multiphase models.

  - For porous media simulations, the relative velocity resistance formulation is not supported with axisymmetric-swirl when there are non-zero swirl resistances.

  - The junction of a wall with shell conduction enabled and a non-conformal coupled wall is not supported. Such a junction will not be thermally connected, that is, there will be no heat transfer between the shell and the mesh interface wall.

  - After you enable the Eulerian Wall Film model, Fluent will not allow you to save the mesh modifications, such as separating cells, extruding face zones, and changing the cell zones type. If you want to modify the mesh in Fluent, be sure to complete all mesh operations prior to enabling the Eulerian Wall Film model.

  - The Transition SST model (also known as the γ-Re_θ model) is not Galilean invariant and should therefore not be applied to surfaces that move relative to the coordinate system for which the velocity field is computed; for such cases, the Intermittency Transition model (also known as the γ model) should be used instead.

  - In simulations that use the discrete phase model, particle mass may be lost when simulation of transient particles released with constant parcel size is combined with auto-save of case files.

  - User-defined wall functions are not compatible with the Eulerian multiphase formulation and cannot be used.

  - The view factor files generated as part of a surface-to-surface radiation model calculation for version 16.0 or 16.1 of Fluent may not be compatible with newer versions if the **Matching** option was enabled for a mapped interface. For any case file with such a setup, you must recompute the view factors in the newer version to ensure correct results.

- Parallel processing

  - The discrete transfer radiation model (DTRM) is unavailable in the parallel solver.

  - Note that on systems using large pages for memory allocation (such as Cray), the virtual memory usage reported by Fluent may be much higher than actual memory used. In this case resident memory (also reported by Fluent) is a more reliable guide.

  - The Eulerian Wall-film model is not compatible with the DPM Domain option of the hybrid parallel DPM tracking. For such model combination, the **Use DPM Domain** option must be disabled in the **Parallel** tab of the **Discrete Phase Model** dialog box.

  - Starting in version 18.0, Ansys Fluent will require approximately 60 MB more memory per node process compared to version 17.0–17.2.

  - If you have OpenSSH inside C:\windows\system32 and want to run a mixed Windows-Linux simulation, Fluent may not be able to locate and execute the ssh command, and the following warning will be printed:

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```
'ssh' is not recognized as an internal or external command, operable
program or batch file.
```

You must specify the path of the actual ssh to be used: launching from the command line, use the `-rsh` option (for example, `-rsh=c:\cygwin64\bin\ssh.exe`); using Fluent Launcher, select **Other** from the **Remote Spawn Control** list in the **Remote** tab and enter the path in the text box (for example, `c:\cygwin64\bin\ssh.exe`).

In addition, you should add the location of `ssh` executable to the beginning of the PATH environment variable. (184255/176971)

- Message Passing Interfaces (MPIs)
  - For Intel MPI + IB on Mellanox OFED 5.1, users will need to specify `-pib.ofed` instead of just `-pib`. (338029)
  - The IBM MPI has been discontinued by the vendor, and is no longer available in the standard installation of Fluent. The Intel MPI is now the default MPI, and is known to have the following limitations:

    → The Intel MPI version upgrade in Fluent release 2019 R1 and later breaks compatibility with older releases on Windows when running on multiple processes. **Workaround:** To switch between running older releases and the latest release on a cluster, you must make sure that the appropriate services have been configured to run by the administrator as follows:

    - To switch from old to new (for example, 19.2 to 2021 R2), run the following command on all nodes from the command prompt with administrator privileges:

      ```
      "C:\Program Files (x86)\IntelSWTools\compilers_and_libraries_2018.3.210\windows\mpi\intel64\bin\
      hydra_service.exe" -install
      ```

    - To switch from new to old (for example, 2021 R2 to 19.2), run the following command on all nodes from the command prompt with administrator privileges:

      ```
      "C:\Program Files (x86)\IntelSWTools\compilers_and_libraries_2017.4.210\windows\mpi\intel64\bin\
      hydra_service.exe" -install
      ```

    After installing both versions of Intel MPI, the `I_MPI_ROOT` environment variable should be deleted from all nodes.

    (180338 / 292942)

    → On Windows or mixed Windows / Linux, it is not possible to dynamically spawn additional processes when switching from meshing mode to solution mode (either by setting the **Meshing Processes** to a lower value than the **Solver Processes** in Fluent Launcher or by using the `/parallel/spawn-solver-process` text command in meshing mode). If you are operating at the **Pro** capability level and you launch with **Solver Processes** > **1**, those cores will also be started in the **Meshing** workspace, but the meshing will occur in serial because parallel meshing is not supported at the **Pro** capability level. (236195 / 257722)

    → By default, the Intel MPI may fail when mixing hardware for compute nodes. **Workaround:** Use the following environment setting:

    ```
    I_MPI_PLATFORM zero
    ```

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If you encounter issues that cannot be remedied using the supported MPI options, you can add the discontinued IBM MPI to your Fluent installation and use it as a last resort. It is provided as-is, and, going forward, Ansys, Inc. may be unable to address any issues reported about IBM MPI. To set it up, locate your Fluent installation and perform the following steps:

→ For Linux:

1. Download the `IBMMPI.gz` package from the following website: https://release212.s3.amazonaws.com/IBMMPI.TGZ?AWSAccessKeyId=AKIAJ6ZOVHCFGGNWYUKA&Expires=1639840801&Signature=nAHWdM6Fhr9JZ594N9Et%2FDb3Naw%3D
2. Move the package to the following directory where Fluent is installed: `ansys_inc/`.
3. Extract the package using the following command in the `ansys_inc/` directory:

```
gunzip < IBMMPI.gz | tar -xvf -
```

→ For Windows:

1. Download the `IBMMPI.zip` package from the following website: https://release212.s3.amazonaws.com/IBMMPI.zip?AWSAccessKeyId=AKIAJ6ZOVHCFGGNWYUKA&Expires=1639840801&Signature=JBuLZJ26WUB%2B28qItrwMoQ9jEUw%3D
2. Extract the package.
3. Copy the `v212` folder from within the extracted package and paste it in the following folder where Fluent is installed: `ANSYS Inc\` (for example, `C:\Program Files\ANSYS Inc\`). This will overlay files in the existing `v212` folder.

– The following error message may be encountered while postprocessing when using the Microsoft MPI (`msmpi`) on Windows:

```
[0] fatal error
Fatal error in MPI_Recv: Other MPI error, error stack:
MPI_Recv(...) failed
Out of memory
```

Workaround: Use the default Intel MPI (`intel`). (267120)

- Platform support and drivers

  – On Windows Server OS, Ansys Fluent supports only MS MPI for parallel runs. Installing the Intel MPI library will result in conflicts.

  – On Windows 7 and later, installing Ansys Fluent on any drive other than `C:` may result in issues arising from spaces in the pathname not getting converted to short file names. This is the result of a change in the default value for `NtfsDisable8dot3NameCreation` starting with Windows 7. If you need to install Ansys Fluent on any drive other than `C:` you must run the following command *prior* to installing Ansys Fluent:

```
fsutil 8dot3name set <driveletter> 0
```

  where *<driveletter>* is the target drive letter including the colon (for example, **D:**).

  – The minimum OS requirements for Linux are SLES 11 SP2 or RHEL 6.

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  - The pathname length to the cpropep.so library (including the lib name) is limited to 80 characters. (Linux Opteron cluster using Infiniband interconnect only.)

  - On Linux platforms, including a space character in the current working directory path is not supported.

  - If you are installing Ansys Fluent 2021 R2 on a Windows machine that already has one or more previous versions of Ansys Fluent, then after installing the Intel MPI library from the prerequisites, make sure to delete the environment variable I_MPI_ROOT. Otherwise there will be a conflict while running previous Ansys Fluent versions in parallel mode.

  - Remote Solver Facility (RSF) is no longer supported in Ansys Fluent.

  - Itanium platform (lnia64) is no longer supported.

  - Ansys Fluent uses several TCP/IP ports for communications and error handling. Port conflicts with other programs trying to use the same ports are handled by Ansys Fluent and generate warnings similar to the following:

    ```
    428: mpt_accept: warning: incorrect exercise message "GET /" from 10.1.0.188 on port 56564
    ```

    Long running large sessions are more prone to generating such warnings, but these are generally safe for you to ignore.

  - If you lock the computer screen before the Fluent graphics are initialized, the Fluent session will not launch if you are using the OpenGL graphics driver. To avoid this issue with the OpenGL driver, you can use the alternative drivers `x11` or `null` for Linux/unix and `msw` or `null` for Windows. You can specify an alternate graphics driver either by defining it in the `HOOPS_PICTURE` environment variable or using the `-driver` Fluent command line option.

  - Fluent may terminate abnormally during launch when running on Community Enterprise OS (CentOS) 7.3 or Red Hat Enterprise Linux (RHEL) 7.3 when DISPLAY is set to a Virtual Network Computing (VNC) session. To attempt to resolve this, verify that you are using a supported graphics card and update the graphics card drivers (directly from the graphics card vendor website). If the issue persists, you can do one of the following: set the DISPLAY to a local machine; set the `LD_PRELOAD` environment variable to `/usr/lib64/libstdc++.so.6`; or use the alternative drivers `x11` or `null` (either by defining it in the `HOOPS_PICTURE` environment variable or using the `-driver` Fluent command line option).

- Remote display

  - Connecting or disconnecting a VPN network while running a Fluent simulation will result in a failure because of changes to the network interface.

  - If you experience an abnormal termination when running Fluent via a remote display, check you graphics card to ensure that you have a modern professional graphics card that is up-to-date (that is, the latest updated driver for that card, which is available on the company's website). If your system does not meet the graphics card requirements, launch Fluent using a completely software-based driver, such as MSW (Windows) or X11 (Linux).

  - (Exceed onDemand and VNC Viewer) The **Num Lock** number keys and arrows may not function in the graphical user interface or console. As a workaround, you can define the `XKB_DEFAULT_RULES`

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environment variable set equal to `base`, which resolves the arrow keys' functionality. Number entries must still be completed using the number keys at the top of the standard keyboard. (172528)

  - (Linux only) When running Ansys Fluent using the Virtual Network Computing (VNC), Nice DCV, or Exceed on Demand (EoD) applications, you may experience unexpected error messages due to a 3rd party issue. To resolve these errors, install the following packages: (185796)

    → xcb-util-wm-0.4.1-5.el6.x86_64

    → xcb-util-keysyms-0.4.0-1.el6.x86_64

    → xcb-util-0.4.0-2.2.el6.x86_64

    → compat-xcb-util-0.4.0-2.2.el6.x86_64

    → xcb-util-image-0.4.0-3.el6.x86_64

  - (Linux only) On some clusters without accelerated graphics, Fluent may not accept keyboard inputs. If you encounter this behavior, set the `QT_XKB_CONFIG_ROOT` environment variable equal to `/usr/share/X11/xkb`.

- Cell Zones and Boundary Conditions

  - A reference frame is always displayed at its initial state (position and orientation) when displayed from the **Reference Frame** dialog box. While running a transient simulation for multiple time steps, a reference frame is displayed at its current state. After the calculation is completed, if you open the **Reference Frame** dialog box and display it, the reference frame triad will move back to its initial state. (184248)

  - Clicking **OK** within the **Reference Frame** dialog box will reset a reference frame to its initial state. If you do not intend to make changes to a reference frame, leave the dialog box by clicking **Cancel**. (184248)

- Reference Frames

  - Fluid zones designated as 3D fan zones cannot have non-conformal interfaces.

- Solver

  - If you have enabled the application of poor mesh numerics using criteria based on the cell gradient quality, the number of cells to which it is applied may vary when performing single-precision calculations with different numbers of processes. Workaround: Use the double-precision solver. (362753)

  - The absolute and relative velocity formulations may yield different results in cases where a strong reversal of flow exists at a pressure outlet boundary.

  - The non-iterative time advancement (NITA) solver is applicable with only a limited set of models. See the Ansys Fluent User's Guide for more details.

  - NITA (using fractional time step method) is not compatible with porous media.

  - The following models are not available for the density-based solvers:

    → Volume-of-fluid (VOF) model

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→ Multiphase mixture model

→ Eulerian multiphase model

→ Non-premixed combustion model

→ Premixed combustion model

→ Partially premixed combustion model

→ Composition PDF transport model

→ Soot model

→ Rosseland radiation model

→ Melting/solidification model

→ Enhanced Coherent Flamelet model

→ Inert model: transport of inert species (EGR in IC engines)

→ Dense discrete phase model

→ Shell conduction model

→ Floating operating pressure

→ Spark ignition and auto-ignition models

→ Physical velocity formulation for porous media

→ Selective multigrid (SAMG)

– The pressure-based coupled solver is not available with the following features:

→ Fixed velocity

– On some Linux platforms, pressing **Ctrl**+**C** will not interrupt the solution. A suggested workaround is to use the checkpoint mechanism in Fluent to save files and/or exit Fluent. (Checkpointing an Ansys Fluent Simulation in the *Fluent User's Guide* (p. 188))

– In certain cases with tetrahedral or hybrid meshes, the use of the Least-Squares Cell Based gradient method in combination with the cell-to-cell limiter may cause divergence. If this is observed, it is recommended that you either change the gradient method to Green-Gauss Node Based or change the limiter type to the cell-to-face limiter.

– Beginning in version 17.0, the warped-face gradient correction (WFGC) is not supported with shell conduction if the ability to define multi-layer shells has been disabled through the `define/models/shell-conduction/multi-layer-shell` text command.

– For transient and time-dependent cases, the solution advances to the next time step based on various inputs including time step size and convergence criteria, but it is not directly dependent

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on the flow time interval specified when 'flow-time' is selected for monitoring (report definitions, autosaving, transient export and so on). For these flow time dependent operations, the action will occur when the flow time meets or exceeds the specified flow time interval.

– Note the following issues affecting residuals:

→ Restarting cases that have the **High Order Term Relaxation** option enabled may produce a small residual jump after the restart. (178223)

→ Restarting cases that have turbulent flow with a wall-function-based boundary treatment and a **No Slip** shear condition at the wall may produce a slightly different residual history compared to a continuous run. (165935)

These issues can occasionally impact the residual history of long transient simulations (such as those that use the LES, SRS, or SBES model) when the solutions for each time step are not deeply converged.

– For case files created in Release 19.2 or earlier and are steady, single phase, and use the pressure-based solver, the **Density** explicit relaxation factor in the **Solution Controls** task page is set to `1` in the following circumstances, even though it should be set to `0.25` (in order to match how a case file created in Release 2019 R1 would behave):

→ if the physics includes reacting flow and/or species transport together with the pseudo transient solution method, and you click the **Default** button in the **Solution Controls** task page

→ if you newly enable one or both of the following so that both are enabled:

- a reacting flow model and/or the species transport model
- the pseudo transient solution method

Work-around: Manually enter `0.25` for **Density** in the **Solution Controls** task page. (182453)

– The following text command works appropriately for setting limits to default values, but fails to take action on solution controls and AMG controls:

```
> solve/set/set-controls-to-default
Set solution controls to default? [no] yes
Set AMG Controls to default? [no] yes
Set limits to default values? [no] yes
```

Work-around: Click the **Default** button in the **Solution Controls** task page and the **Multigrid** tab of the **Advanced Solution Controls** dialog box, respectively. As noted previously, for older steady-state, single-phase cases that use the pressure-based solver and involve reacting flow and/or species transport with the pseudo transient solution method, you must also manually set the **Density** explicit relaxation factor to `0.25` in the **Solution Controls** task page. (183926)

– The use of **Fractional Step** pressure-velocity coupling scheme with dynamic mesh layering is not supported. To run this combination, enter the following Scheme command before running the calculation: `(rpsetvar 'dynamesh/layering/layering-before-move? #t)`. (125886)

- User-Defined

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  - For expressions evaluated for zone motion (moving reference frame or moving mesh), "Time" evaluates to the previous time step's flow time, whereas the "Time" argument of a DEFINE_TRANSIENT_PROFILE used for zone motion will have the current time step's flow time. (147162)

  - When you use curly brackets "{}" to specify the name of a defined object, such as a report definition or a cell register, automatic suggestions are disabled and you must provide the display name of that object. (118322)

  - Expressions defined for fields in the **Fixed Values** tab of the **Fluid** and **Solid** cell zone dialog boxes cannot include units in the expression definition. (146295)

  - Any scripts or journals that attempt to add menu items to Fluent pull-down menus (which have been replaced with the Fluent ribbon) will no longer work. You must create separate user-defined menus to house all user-defined menu items. For additional information about user-defined menus, see Adding Menus to the Right of the Ribbon in the *Fluent Customization Manual*.

- User-defined functions (UDFs)

  - Interpreted UDFs cannot be used with an Infiniband interconnect or, when running in parallel, on the Cray platform. The compiled UDF approach must be used instead.

  - The **Visual Studio Express 2015 for Windows** installer on Windows 10 installs libraries in non-standard locations. To ensure the use of Microsoft Visual Studio for UDF compiling (rather than the built-in compiler provided with the Fluent installation), you must instead use the **Visual Studio Express 2015 for Desktop** installer, or manually set the library path based on your local installation (for example, LIB="C:\Program Files (x86)\Microsoft Visual Studio 14.0\VC\lib\onecore\amd64";%LIB%).

- Graphics, Reporting, and Postprocessing

  - (Linux only) Contour lines are not displayed when dynamic shadows are enabled. To make the contour lines display, you can disabled dynamic shadows either in the graphics window toolbar or in Preferences. (343770)

  - Keyframe **Scene Animations** of pathlines are only available for the non-persistent/"global" version of the **Pathlines** dialog box that does not have a **Name** field. This version of the dialog box is opened as described below: (269934)

    → Right-clicking **Pathlines** in the Outline View tree and selecting **Edit...** (located under the **Results** branch).

    → Clicking **Pathlines** and selecting **Edit...** under **Graphics** in the **Results** ribbon tab.

  - Unsteady statistics mean and rms values for custom field functions defined for dp/dt may show as zero. Contact support for a workaround. (199006)

  - (2D Only) Box select is only working for selecting surfaces if you drag from right-to-left. However, you can enable **Edges** or **Faces** in the **Mesh Display** dialog box to restore left-to-right box selection. You can also enable **Show model edges** in the **Appearance** branch of **Preferences** (accessed via **File**>**Preferences...**) to change the default mesh display behavior. (259419)

  - When you use curly brackets "{}" to specify the name of a defined object, such as another report definition, automatic suggestions are disabled and you must provide the display name of that object. (118322)

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- When exporting a filled contour with contour lines to AVZ format, the contour lines will not be visible in the Ansys Viewer. As a workaround, you can create a scene containing 2 duplicate contour plots—one with filled contours, one with just contour lines (not filled). You can also disable the colormap for one of the plots so the plot only contains a single colormap. (137138)

- Monitors may continue to print/plot values, even if the zones on which they are defined are deactivated.

- If you are autosaving multiple scenes on a Windows machine, the **Headlight** lighting effect may inconsistently change its state (on/off). This can be avoided by rendering each scene in a separate graphics window.

- Mean and root-mean-squared-error (RMSE) quantities of custom field functions are only available for mixtures. In previous releases it was possible to specify these quantities for phases, which was an incorrect behavior. This behavior is no longer allowed in R16.0 or later releases. If you are running a pre-R16.0 case set to output such quantities in R2021 R2, you may get a segmentation error. To avoid the error, redefine the previously defined monitors reporting mean or RMSE quantities of phases.

- The mouse-annotate feature is no longer available. Annotations can still be created using the Annotate dialog box (see Annotate Dialog Box in the *Fluent User's Guide* (p. 4555) for additional information).

- Beginning in version 15.0, if a flux report for the heat transfer rate is generated on the wall of a moving solid, the reported values will include the convective heat flux due to the motion of the solid. Depending on the mesh and quality of the geometry representation, this may present flux values that are different than the flux specified in the boundary condition definition (for example, a non-zero flux may be reported for an adiabatic wall).

- If you import a case file that was created prior to Release 18.0 and that contains multiple monitors plotting in the same window, you must review the setup to ensure each report plot is assigned to a different window before running the calculation. If the plot windows are not reassigned, then plots assigned to the same window will be lost.

- It is possible to use text commands to create contour, vector, mesh, pathline, particle track, XY plot, and scene graphics objects with spaces in the name (for example, through the `display/objects/create` text command); however, objects with such names cannot be displayed using the `display/objects/display` text command, and attempting to do so will only result in the printing of an error. As a workaround, you can create graphics objects without spaces in the name or use the graphical user interface to display graphics objects with spaces in the name.

- In rare cases, the **Curve Length X Axis Function** for XY plots may not plot correctly, even if the curvilinear surface is piecewise linear and appears to be a single closed curve. A workaround is to use the **Direction Vector X Axis Function**.

- Transient statistics (Mean and RMS) reported for Fluent quantities that are nonlinear functions of the underlying solution variables represent evaluations of those quantities using the Mean or RMS values of the underlying solution variables. For instance, **Mean Velocity Magnitude** is computed as the magnitude of a vector constructed from the mean velocity components, and **Mean Pressure Coefficient** is computed as the pressure coefficient computed using the mean pressure. To construct the true Mean and/or RMS values of such quantities, you can define a custom field function and collect transient statistics of the custom field function. For example, define a custom field function **vmag_cff** = **sqrt (Vx ^ 2 + Vy ^ 2 + Vz ^ 2)**, and report Mean and RMS of **vmag_cff**.

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– Scene animations created using **Key Frames** in the **Animate** dialog box are not compatible with graphics displays on isosurfaces (contours, vectors, pathlines, particle tracks). Pathlines are not compatible with scene animations, regardless of the selected surface(s).

– When meshes contain a large number of cells (for example, ~150 million cells or higher), the meshing mode of Fluent may report an incorrect number of skewed cells, based on an incorrect inverse orthoskew (IOS) value. As a workaround, you can use the `(tgapi-util-set-number-of-parallel-compute-threads 1)` command. (168453)

– If you create an XY plot for display on a rake surface and you use the savable XY plot graphics object, accessed by clicking **New...** in the ribbon or outline view, then the results may not be displayed immediately. If they do not appear, click **Curves...** in the **XY Plot** dialog box and select a **Symbol** from the drop-down list in the **Marker Style** group box, click **Apply**, then redisplay the XY plot. (180547)

  If you are viewing cell values (**Node Values** disabled) on an XY plot of a rake surface and the points are being shown as a continuous line, then you can change the **Pattern** to "empty" in the **Curves - Solution XY Plot** dialog box (**Line Style** group box). (180547)

– The transform operation in the **Transform Surface** dialog box is not available for user-created surfaces such as lines, points, iso-surfaces, and so on. To create a transformed line, point, iso-surface, or other user-created surface, you must manually translate the input point(s) and create a new line/point/iso-surface in the respective dialog box (**Line/Rake**, **Point Surface**, **Iso-Surface**, and so on).

– Density contour plots that include a solid region in the display will include the solid zone(s) in any range calculations and will show a density for the solid that does not reflect the actual case setup. Fluid zone densities are still displayed correctly. Selecting **Density...** and **Density All** in the **Contours of** drop-down lists will correctly display density values for solids and fluids. (155346)

– Special characters (/^*%@,<>{}()?&~!=) should not be used in object names: they can affect how an object is rendered in the graphics display, and may make it so the object does not appear at all. (157473)

– For annotations, the **foreground** and **background** color options for text are not in sync with those specified in **Preferences**, but are instead controlled using the `display/set/colors/foreground` and `display/set/colors/background` text commands, respectively.

– For any meshing mode or solution mode session that displays graphics in the graphics window (including when running a batch job with the `-gu` command line option) and/or saves picture files, the rendering / saving speed will be significantly slower if you do not follow all of the following best practices:

  → Run Cortex on a suitable machine with an appropriate graphics card and the latest drivers (for details, see the Ansys website). Note that you can assign Cortex to a particular machine using the `-gui_machine=<hostname>` command line option, or by selecting **Specify Machine** from the **Graphics Display Machine** list in the **Scheduler** tab of Fluent Launcher.

  → Ensure that Cortex / the host process is run on a separate machine than that used for compute node 0. For example, do not include the machine assigned using the `-gui_machine` option as the first machine in the hosts file / machine list (specified using the `-cnf=x` command line option).

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→ Do not set the graphics driver to `null`, `x11` (for Linux), or `msw` (for Windows).

→ When saving picture files, enable the **Fast hardcopy** option in the **Preferences** dialog box (under **Graphics**).

– Right-clicking point surfaces to display them from the Outline View tree is not working due to a 3rd party issue. As a workaround, you can display point surfaces using the **Mesh Display** dialog box. (181843)

• Fluent in Workbench

– In a Workbench project, if your Fluent case and data files are in the default common fluids format (CFF) and you also export a .cdat file, you may get an error message if you attempt to postprocess the results using CFD-Post. This is because when a .cdat file is exported, a legacy case file (.cas) is also written as the latest case, and so paired with the CFF data file (.dat.h5), and it is not possible to use a combination of legacy and CFF files in CFD-Post. Workaround: Manually write a new .cas.h5 and .dat.h5 file after the .cdat file is exported. (310992)

– When using Fluent in Workbench, importing Fluent Case and Data into a Fluent system will cause project updates to fail if **Submit** to **Design Point Service** is chosen for **Update Option**. As a workaround, you can right-click the **Solution** cell and choose**Refresh** prior to the project update, or select **RSM** under **Update Option** in the **Project Schematic Properties**. Projects that use the Import Fluent Case functionality only (without importing Data) or that start from Geometry/Mesh without Case file import are unaffected by this limitation. (277667)

– The **Automatic Skip** option for colormaps is not functioning as intended. As a workaround, you can manually specify the skip value. (273989)

– Fluent cases with either of:

→ Legacy (pre-18.0) solution monitors that get converted to report definitions.

→ Report file objects in which no filename is specified (from any release).
may fail if updated in Workbench with the following message: "Update failed for the Solution component in Fluent. Value cannot be null. Parameter name: fileName". To avoid this issue you can first read the case into Fluent and either 1) delete the report file or 2) specify a valid filename for the report file. (146221)

– Coupling between Fluent and HFSS or Q3D Extractor is not supported.

– For two-way coupling between Maxwell and Fluent, by default Fluent uses the following zones: when mapping volumetric losses, the same list of zones that you selected for receiving volumetric losses in Fluent's **Maxwell Mapping Volumetric** dialog box are used; and when mapping surface losses, all cell zones are used. To change the zones that are used for feedback mapping, you can use a Scheme command, shown in the following example. This example specifies that only cell zone ID 1 and 2 are used: `(em-set-feedback-map-cell-zone '(1 2))`. Note that you can only specify the IDs of the cell zones as the arguments.

– In a Fluent analysis system, the **Clear Generated Data** option for the **Solution** cell will not clear the files associated with animations. To have the **Clear Generated Data** option clear the animation files as well, you must define the `FLUENT_WB_REMOVE ALL_GENERATE_FILES` as a system environment variable on your local machine, prior to opening Workbench.

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- Fluent as a Server
  - When running Fluent with the `-aaS` option, if you have a mesh with a very low cell count and have set a large number of iterations to be stored using the **Residual Monitors** dialog box (see Storing Residual History Points in the *Fluent User's Guide* (p. 3262)), you will see a relative degradation of performance. Reducing the number of stored iterations will reduce this degradation.
  - When launching Fluent with the `-gu` or `-g` command line options and Fluent as a server enabled, Fluent will run with the graphic user interface minimized.
- Third-party software
  - Fluent-Platform LSF integration is not supported on the MS Windows platform.
  - Fluent-SGE integration is supported only on Linux platforms.
  - Wave and GT-POWER coupling are available only with stand-alone Ansys Fluent and not in the Workbench environment.
  - Supported versions of third-party software are listed below:

Table 1.1: Supported Versions of Third-Party Software

Third-Party Software	Supported Version
Abaqus	6.14 ODB Library: 6.14.5
Altair HYPERMESH	5.1
AVS	5.0
CGNS	3.3.1
Cray MPI (MPT)	7.0
Data Explorer	4.2
EnSight 6 (TUI only)	Ensight 6
EnSight Case Gold	10.1.6
FAST	1.3
Fieldview	16.0
GT-POWER	Version 2021 Build 1
Hierarchical Data Format version 5 (HDF5)	1.10.5
HOOPS	23.00-1
I-deas	I-deas NX Series 11
Intel MPI	Linux: 2018.3.222 Windows with distributed memory on a cluster: 2018.3.210 Windows with shared memory on a local machine: 2019.8.254
libpng	1.6.18
LSTC-DYNA	970.0

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Third-Party Software	Supported Version
Microsoft MPI	10.0
MPCCI	3.0.5
NASTRAN	Bulk data input file - MSC.NASTRAN 2010 OUTPUT2 data file - NX/NASTRAN 10
NIST	9.1
Open MPI	4.0.5
PATRAN	3.0
PTC MECHANICA	PTC/Mechanica Wildfire 4.0
Sundials	2.5.0
TECPLOT	Tecplot file format, version 11.2
VKI	4.4.6.r1
WAVE	2020.2
zlib	1.2.8

- Other
  - Images of embedded graphics windows captured using the Save Picture dialog box are saved without borders on the embedded windows, regardless of the setting specified in Preferences. (336851)
  - (Operating under the **Pro** license) While the **user-defined** specification method is available for some fields, such as material properties, you cannot load user-defined functions, as they are not supported at the Pro capability level. (321331)
  - Exports of Common Fluids Format - Post files from Fluent may incorrectly specify the pressure gradient as zero. Contact support for a workaround. (239127, 243318)
  - If the network connection is lost during a serial or parallel calculation, the Fluent session may terminate abnormally.
  - The IRIS Image and HPGL hard copy formats are no longer supported in Ansys Fluent.
  - When using Ansys Fluent with the Remote Solve Manager (RSM):

    → Only one copy of a saved project that is in the pending state can reconnect successfully.

    → Maxwell coupling is not supported.

    → UDFs are supported with limitations as detailed in Submitting Fluent Jobs to Remote Solve Manager in Workbench User's Guide.
  - The turbo-averaged contour plot in turbomachinery postprocessing may give an unexpected contour region in a selected topology.
  - The **Inverse Distance** and **Least Squares** profile interpolation methods are not applicable when a profile is attached to cell zones.

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  - When opening Ansys Help from Fluent in Linux, you may receive an error message in the Linux console. This can result when another user has created the installation and run Fluent, thus creating a registry file; if you then run this same installation, there will be a permissions conflict. As a workaround, remove the registry file:

    path`/ansys_inc/v212/Tools/mono/Linux64/etc/mono/registry`

    (where *path* is the directory in which you have placed the release directory). Then change the permissions for the Mono platform in order to remove write access from the directory:

    path`/ansys_inc/v212/Tools/mono/Linux64/etc/mono`

  - On Windows, mesh reading into a serial Ansys Fluent session may fail if you use more than 20 million cells per core.

  - Fluent does not support non-ASCII characters in the names of files, zones, and boundaries.

  - When exiting a Fluent session on Linux that was started with the Load ACT option, Fluent may become unresponsive. If this occurs, the Fluent process must be manually terminated. In the console, the error message specifies that a corrupted double-linked list is responsible for the error. Because this unexpected shutdown occurs after the project has been saved, no data is lost.

  - When Fluent is run on Linux with the Load ACT option, Fluent may repeatedly issue the following warning during solution iteration:

    ```
    Unexpected error checking licensing server.
    ```

    This warning is harmless and does not impact Fluent or ACT usage.

  - When running a stand-alone instance of Fluent in a mixed Windows / Linux configuration or from a remote Windows installation, ACT does not open. To correct the problem, you must set the `AWP_ROOT212` environment variable to point to the Ansys installation directory.

  - ACT with Ansys Fluent is disabled on Linux systems starting in Release 19.2. To use ACT with Ansys Fluent, use Release 19.2 or later on Windows or use Release 19.1 on Linux. (177173)

  - If the network connection is lost during a serial or parallel calculation, the Ansys Fluent session may terminate abnormally.

  - Ansys Fluent uses several TCP/IP ports for communications and error handling. Port conflicts with other programs trying to use the same ports are handled by Ansys Fluent and generate warnings similar to the following

    ```
    428: mpt_accept: warning: incorrect exercise message "GET /" from 10.1.0.188 on port 56564
    ```

    Long running large sessions are more prone to generating such warnings, but these are generally save for you to ignore.

- Remote Visualization Client

  - When running Ansys Fluent utilizing VirtualGL `vglrun` or EOD `ssrun`, Fluent may hang when writing image files. As a workaround, disable **Use hardware acceleration** under **Save Picture Settings** in the **Graphics** branch of **Preferences** (accessed via **File**>**Preferences**...). (252910)

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  - For a client session with multiple connected servers, only one server can receive commands through the **Send Command to Server** dialog box—that server is whichever one you send a command to first using this dialog box. As a workaround, you can use the Python console to control the other connected servers. (177632)

- Fluent Meshing

  - Limitations related to the Fluent guided meshing workflows are documented separately. See Limitations of the Fluent Guided Workflows (p. 263) for details.

  - *Before* importing SpaceClaim files (`.scdoc`) into Fluent Meshing, you need to first enable the **Set as the alternative license preference** license preference option in SpaceClaim in order to uphold licensing preferences.

  - Using journal (`*.jou`) or workflow (`*.wft`) files from previous releases may slow or even halt the volume mesh generation process. **Workaround:** For journal files, make sure that you add version-specific information to the beginning of your journal files (for example: `/file/set-tui-version "19.5"`). For workflow files, make sure that you have the **Quality Warning Limit** property in the **Create Volume Mesh** task set to a value closer to 0 (such as 0.05) instead of a value near 1. (163320)

  - While writing case files in the CFF format (`.cas.h5`) in a mixed Windows/Linux environment, Fluent Meshing will only write files on the Linux nodes. To write such case files properly, you have to assign a mapped driver on the Windows side as the working directory, and then assign the remote working directory to the same path, where the mapped driver path is derived from.

  - (Linux only) Geometries imported from Ansys Mechanical, Ansys DesignModeler, and Ansys Meshing depend on the Linux `xmessage` command. The following RedHat package managers should be installed before runtime:

    → For SLES, xmessage-1.0.4-5.58.x86_64 (version may differ)

    → For RHEL, xorg-x11-apps

  - Meshes generated from Ansys Meshing that are then imported into Fluent Meshing may not include all interior faces. **Workaround:** In Ansys Meshing, ensure that all interior surfaces are assigned to be internal faces (that is, put into a Named Selection that includes the name "internal") before generating the mesh, such that all internal surfaces will then be accounted for when the mesh is imported into Fluent Meshing.

  - After Ansys Fluent 19.2, you can no longer have multiple interior zones defined in a single cell zone. If your case file has such zones, they will not appear as available zones. **Workaround:** Read the mesh file into Ansys Fluent 19.2, and set the type for the interior zones to be 'wall' in order to restore the missing zones. (143347)

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Chapter 2: Basic Steps for CFD Analysis using Ansys Fluent

Before you begin your CFD analysis using Ansys Fluent, careful consideration of the following issues will contribute significantly to the success of your modeling effort. Also, when you are planning a CFD project, be sure to take advantage of the customer support available to all Ansys Fluent users.

For more information, see the following sections:

2.1. Steps in Solving Your CFD Problem
2.2. Planning Your CFD Analysis

2.1. Steps in Solving Your CFD Problem

Once you have determined the important features of the problem you want to solve, follow the basic procedural steps shown below.

1. Define the modeling goals.
2. Create the model geometry and mesh.
3. Set up the solver and physical models.
4. Compute and monitor the solution.
5. Examine and save the results.
6. Consider revisions to the numerical or physical model parameters, if necessary.

Step 2. of the solution process requires a geometry modeler and mesh generator. You can use DesignModeler and Ansys Meshing within Ansys Workbench or you can use a separate CAD system for geometry modeling and mesh generation. When meshing 3D geometries, you can also use the meshing mode of Fluent. Alternatively, you can use supported CAD packages to generate volume meshes for import into Ansys Fluent (see the User's Guide (p. 1)). For more information on creating geometry and generating meshes using each of these programs, refer to their respective manuals.

The details of the remaining steps are covered in the User's Guide (p. 1).

2.2. Planning Your CFD Analysis

For each of the problem-solving steps, there are some questions that you need to consider:

- **Defining the Modeling Goals**
  - What results are you looking for, and how will they be used?

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→ What are your modeling options?

→ What physical models will need to be included in your analysis?

→ What simplifying assumptions do you have to make?

→ What simplifying assumptions can you make?

→ Do you require a unique modeling capability?

- Could you use user-defined functions (written in C)?

– What degree of accuracy is required?

– How quickly do you need the results?

– How will you isolate a piece of the complete physical system?

– Where will the computational domain begin and end?

→ Do you have boundary condition information at these boundaries?

→ Can the boundary condition types accommodate that information?

→ Can you extend the domain to a point where reasonable data exists?

– Can it be simplified or approximated as a 2D or axisymmetric problem?

- **Creating Your Model Geometry and Mesh**

  Ansys Fluent uses unstructured meshes in order to reduce the amount of time you spend generating meshes, to simplify the geometry modeling and mesh generation process, to enable modeling of more complex geometries than you can handle with conventional, multi-block structured meshes, and to enable you to adapt the mesh to resolve the flow-field features. Ansys Fluent can also use body-fitted, block-structured meshes (for example, those used by Ansys Fluent 4 and many other CFD solvers). Ansys Fluent is capable of handling triangular and quadrilateral elements (or a combination of the two) in 2D, and tetrahedral, hexahedral, pyramid, wedge, and polyhedral elements (or a combination of these) in 3D. This flexibility enables you to pick mesh topologies that are best suited for your particular application, as described in the User's Guide (p. 1).

  For 3D geometries, you can create the mesh using the meshing mode of Fluent; otherwise, you must generate the initial mesh (whatever the element types used) outside of Fluent or use one of the CAD systems for which mesh import filters exist. When in solution mode, Fluent can be used to adapt all types of meshes (except for polyhedral), in order to resolve large gradients in the flow field.

  The following questions should be considered when you are generating a mesh:

  – Can you benefit from other Ansys, Inc. products such as CFX or Ansys Icepak?

  – Can you use a quad/hex mesh or should you use a tri/tet mesh or a hybrid mesh?

  → How complex is the geometry and flow?

  → Will you need a non-conformal interface?

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  - What degree of mesh resolution is required in each region of the domain?

    → Is the resolution sufficient for the geometry?

    → Can you predict regions with high gradients?

    → Will you use adaption to add resolution?

  - Do you have sufficient computer memory?

    → How many cells are required?

    → How many models will be used?

- **Setting Up the Solver and Physical Models**

  For a given problem, you will need to:

  - Import and check the mesh.
  - Select the numerical solver (for example, density based, pressure based, unsteady, and so on).
  - Select appropriate physical models.

    → Turbulence, combustion, multiphase, and so on.

  - Define material properties.

    → Fluid

    → Solid

    → Mixture

  - Prescribe operating conditions.
  - Prescribe boundary conditions at all boundary zones.
  - Provide an initial solution.
  - Set up solver controls.
  - Set up convergence monitors.
  - Initialize the flow field.

- **Computing and Monitoring Your Solution**

  - The discretized conservation equations are solved iteratively.

    → A number of iterations are usually required to reach a converged solution.

  - Convergence is reached when:

    → Changes in solution variables from one iteration to the next are negligible.

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    - Residuals provide a mechanism to help monitor this trend.

  → Overall property conservation is achieved.

– The accuracy of a converged solution is dependent upon:

  → Appropriateness and accuracy of physical models.

  → Mesh resolution and independence.

  → Problem setup.

- **Examining and Saving Your Results**

  Examine the results to review the solution and extract useful data.

  – Visualization tools can be used to answer such questions as:

    → What is the overall flow pattern?

    → Is there separation?

    → Where do shocks, shear layers, and so on form?

    → Are key flow features being resolved?

  – Numerical reporting tools can be used to calculate the following quantitative results:

    → Forces and moments

    → Average heat transfer coefficients

    → Surface and volume integrated quantities

    → Flux balances

- **Revising Your Model**

  Once your solution is converged, the following questions should be considered when you are analyzing the solution:

  – Are physical models appropriate?

    → Is flow turbulent?

    → Is flow unsteady?

    → Are there compressibility effects?

    → Are there 3D effects?

  – Are boundary conditions correct?

    → Is the computational domain large enough?

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→ Are boundary conditions appropriate?

→ Are boundary values reasonable?

– Is the mesh adequate?

→ Can the mesh be adapted to improve results?

→ Does the solution change significantly with adaption, or is the solution mesh independent?

→ Does boundary resolution need to be improved?

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Chapter 3: Guide to a Successful Simulation Using Ansys Fluent

The following guidelines can help you make sure your CFD simulation is a success. Before logging a technical support request, make sure you do the following:

1. Examine the quality of the mesh in Fluent.

   There are two basic things that you should do before you start a simulation:

   - Perform a mesh check to avoid problems due to incorrect mesh connectivity, and so on. In particular, you should be sure that the minimum reported cell volume is not negative.
   - Look at maximum cell skewness (for example, using the **Compute** button in the **Contours** dialog box after initializing the model). As a rule of thumb, the skewness should be below 0.98. You can also use the **Report Quality** function to calculate the minimum cell orthogonality. You can find more details about mesh quality considerations in Mesh Quality in the *Fluent User's Guide* (p. 1031).

   If there are mesh problems, you may have to re-mesh the problem.

2. Scale the mesh and check length units.

   In Ansys Fluent, all physical dimensions are initially assumed to be in meters. You should scale the mesh accordingly. Other quantities can also be scaled independently of other units used. Ansys Fluent defaults to SI units.

3. Employ the appropriate physical models.

4. Set the energy under-relaxation factor between 0.95 and 1.

   For problems with conjugate heat transfer, when the conductivity ratio is very high, smaller values of the energy under-relaxation factor practically stall the convergence rate.

5. Use node-based gradients with unstructured tetrahedral meshes.

   The node-based averaging scheme is known to be more accurate than the default cell-based scheme for unstructured meshes, most notably for triangular and tetrahedral meshes.

6. Monitor convergence with residuals history.

   Residual plots can show when the residual values have reached the specified tolerance. After the simulation, note if your residuals have decreased by at least 3 orders of magnitude to at least 10^{-3}. For the pressure-based solver, the scaled energy residual must decrease to 10^{-6}. Also, the scaled species residual may need to decrease to 10^{-5} to achieve species balance.

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You can also monitor lift, drag, or moment forces as well as pertinent variables or functions (for example, surface integrals) at a boundary or any defined surface.

7. Run the CFD simulation using second order discretization for better accuracy rather than a faster solution.

   A converged solution is not necessarily a correct one. You should use the second-order upwind discretization scheme for final results.

8. Monitor values of solution variables to make sure that any changes in the solution variables from one iteration to the next are negligible.

9. Verify that property conservation is satisfied.

   After the simulation, note if overall property conservation has been achieved. In addition to monitoring residual and variable histories, you should also check for overall heat and mass balances. At a minimum, the net imbalance should be less than 1% of the smallest flux through the domain boundary.

10. Check for mesh dependence.

    You should ensure that the solution is mesh-independent and use mesh adaption to modify the mesh or create additional meshes for the mesh-independence study.

11. Check to see that the solution makes sense based on engineering judgment.

    If flow features do not seem reasonable, you should reconsider your physical models and boundary conditions. Reconsider the choice of the boundary locations (or the domain). An inadequate choice of domain (especially the outlet boundary) can significantly impact solution accuracy.

You are encouraged to collaborate with your technical support engineer in order to develop a solution process that ensures good results for your specific application. This type of collaboration is a good investment of time for both yourself and the Ansys Fluent support engineer.

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Chapter 4: Starting and Executing Ansys Fluent

This chapter provides instructions for starting and executing Ansys Fluent.

4.1. Starting Ansys Fluent

4.2. Running Ansys Fluent in Batch Mode

4.3. Switching Between Meshing and Solution Modes

4.4. Checkpointing an Ansys Fluent Simulation

4.5. Cleaning Up Processes From an Ansys Fluent Simulation

4.6. Exiting Ansys Fluent

4.1. Starting Ansys Fluent

The following sections describe how start Ansys Fluent:

Important:

- Ensure your graphics driver is up-to-date to avoid issues with graphics displays (such as the display coming upside-down).
- If your %HOMEDRIVE% environment variable is set to a network drive and you experience issues such as delays in the Fluent Launcher appearing, add a copy of the preferences file to the %HOMEDRIVE% network location (`%HOMEDRIVE%%HOMEPATH%\.fluent-conf\21.2.0\preferences`). Refer to Setting User Preferences/Options (p. 832) for additional information on the preferences file location.

4.1.1. Selecting the Licensing Level

4.1.2. Starting Ansys Fluent Using Fluent Launcher

4.1.3. Starting Ansys Fluent on a Windows System

4.1.4. Starting Ansys Fluent on a Linux System

4.1.5. Command Line Startup Options

4.1.1. Selecting the Licensing Level

You specify the licensing level using the **Capability Level** drop-down list in the Fluent Launcher. The feature availability at the different licensing levels is discussed in Program Capabilities (p. 135).

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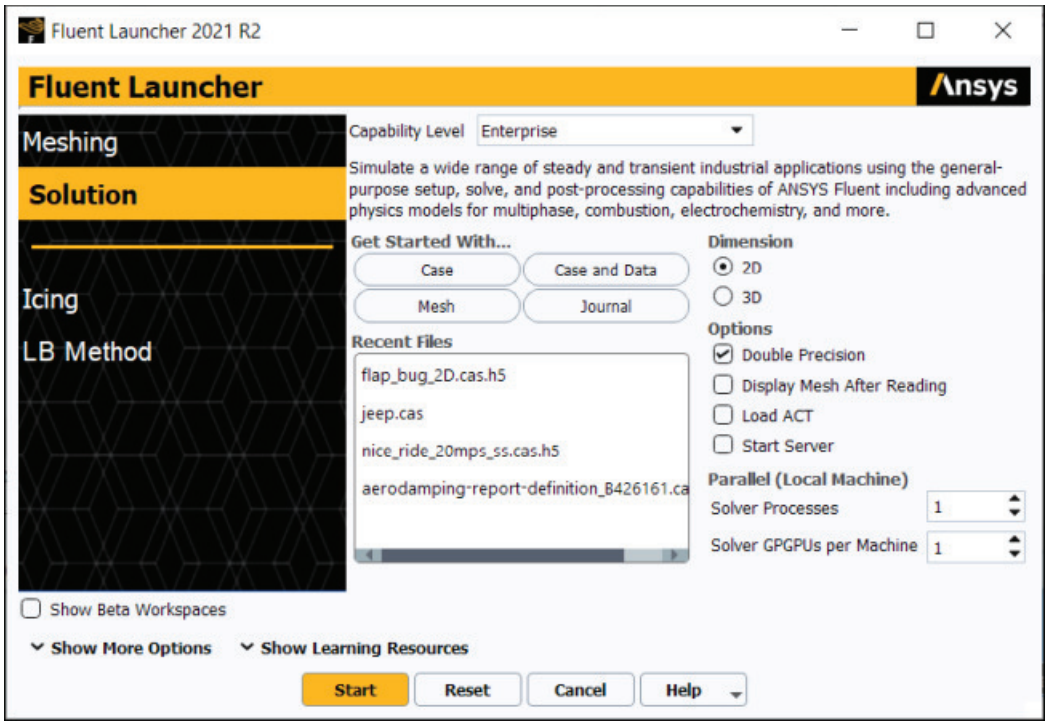
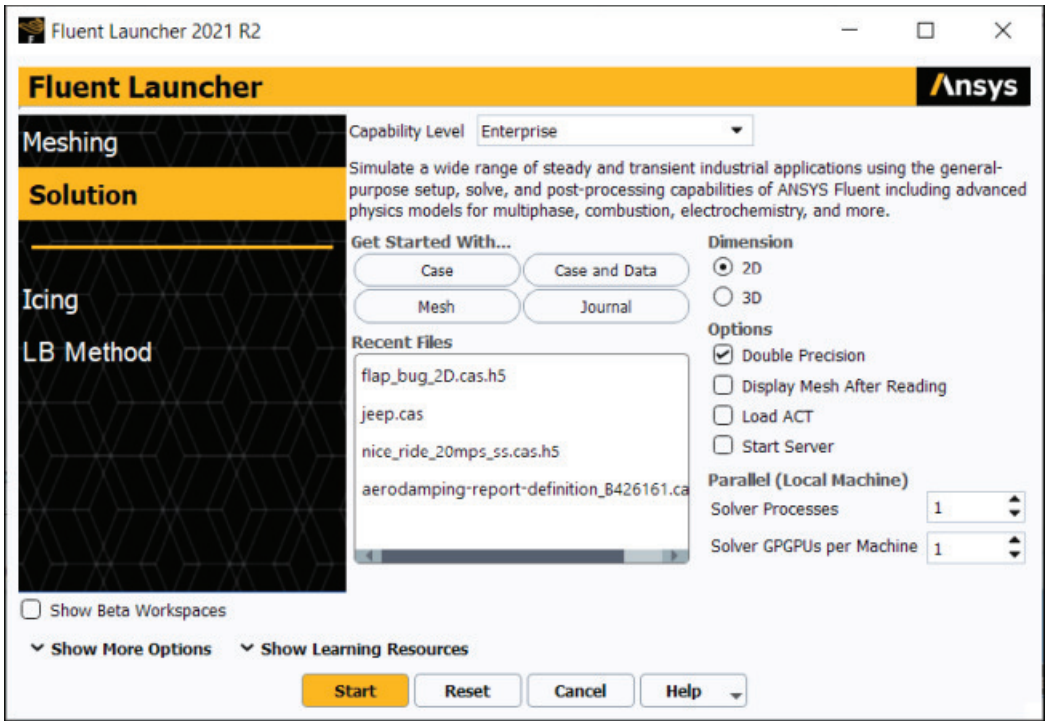


4.1.2. Starting Ansys Fluent Using Fluent Launcher

You can interactively specify Ansys Fluent dimension, display, processing and other options using the Fluent Launcher.



To start the Fluent Launcher, do one of the following:

- Start Ansys Fluent from the Linux or Windows command line with no arguments.

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- Start Ansys Fluent from the Windows Start menu.
- Start Ansys Fluent from the Windows desktop or Quick Launch bar.

Any options set in the Fluent Launcher will be retained for your next session.

Select the workspace you plane to use (the dividing line in the launcher separates the general-purpose Meshing and Solution workspaces from the application-specific option):

- **Meshing**—See Introduction to Meshing Mode in Fluent (p. 199) and subsequent chapters for further details about using the Fluent Meshing workspace.
- **Solution**—See Graphical User Interface (GUI) (p. 801) and subsequent chapters for further details about using the Fluent Solution workspace.
- **Icing**—See Fluent Icing (p. 4981) for further details about using the Fluent Icing workspace.

*You can enable **Show Beta Workspaces** to expose additional workspaces that are not yet considered "full" features. These workspaces are documented in the Fluent User's Guide (p. 1).*

Important:

The available workspaces depends on your licensing level. To learn more about your licensing options, refer to the Ansys Licensing documentation or speak with your sales representative.

Select a case| case and data | mesh | journal file to start with or specify the **Dimension** of the simulation you intend to perform. *Beginning with a journal file allows you to automatically load the case, compile any user-defined functions, iterate until the solution converges, and write results to an output file.*

Note:

Selecting a case file from the **Recent Files** list only loads the case file (after clicking **Start With Selected Options**), even if there is an associated data file in the same directory.

Select your required **Options**.

- Choose to **Display Mesh After Reading** (disabled by default). This option is applicable only to volume meshes and not surface meshes. All of the boundary zones will be displayed except for the interior zones of 3D geometries.

  Note:

  You can override this option on a file-by-file basis using the **Display Mesh After Reading** option in the **Select File** dialog box that opens when you are reading in a file.

- Enable the **Load ACT** option to load Ansys ACT. For additional information on ACT, see Customizing Fluent in the *Fluent User's Guide* (p. 3983).

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- Choose to perform solution calculations in **Double Precision** mode, if desired. (Default is single-precision mode) See Single-Precision and Double-Precision Solvers (p. 168) to help with your decision.

  Note:

  The **Meshing** workspace is always run in **Double Precision**. This option applies for the Solution workspace only.

- Enable **Start Server** to launch the Fluent workspace as a server so that you can launch the Fluent Remote Visualization Client and connect to this Fluent session. Refer to Remote Visualization and Accessing Fluent Remotely (p. 4945) to learn more about this option.

Select your **Parallel (Local Machine)** options.

- Set **Meshing Processes** to **1** to restrict the meshing calculations to a single processor core.
- Set **Solver Processes** to **1** to restrict the solution calculations to a single processor core.
- Set **Meshing Processes** more than 1 to allow multiple simultaneous processes. *Note that increasing the number of meshing processes also increases the solver processes to the same processor count.* See Setting Parallel Options in Fluent Launcher (p. 169) for additional information.
- Set **Solver Processes** more than 1 to allow multiple simultaneous processes. See Setting Parallel Options in Fluent Launcher (p. 169) for additional information.
- Set **Solver GPGPUs per Machine** to more than 0 to utilize your graphics card for solver computations.

Select **Show More Options** to expand the Fluent Launcher window to reveal more options. (Figure 4.1: The General Options Tab of Fluent Launcher (p. 167)). Note that once Fluent Launcher expands, the **Show More Options** button becomes the **Show Fewer Options** button, allowing you to hide the additional options.

Select **Show Learning Resources** to expand the Fluent Launcher window to reveal links to: Documentation, News, Tutorials, Online Resources, and Videos. Note that once Fluent Launcher expands, the **Show Learning Resources** button becomes the **Hide Learning Resources** button, allowing you to hide the links.

Important:

Fluent Launcher also appears when you start Ansys Fluent within Ansys Workbench. For more information, see the separate Ansys Fluent in Workbench User's Guide.

4.1.2.1. Setting General Options in Fluent Launcher

Set file and path options using the **General Options** tab in Fluent Launcher.

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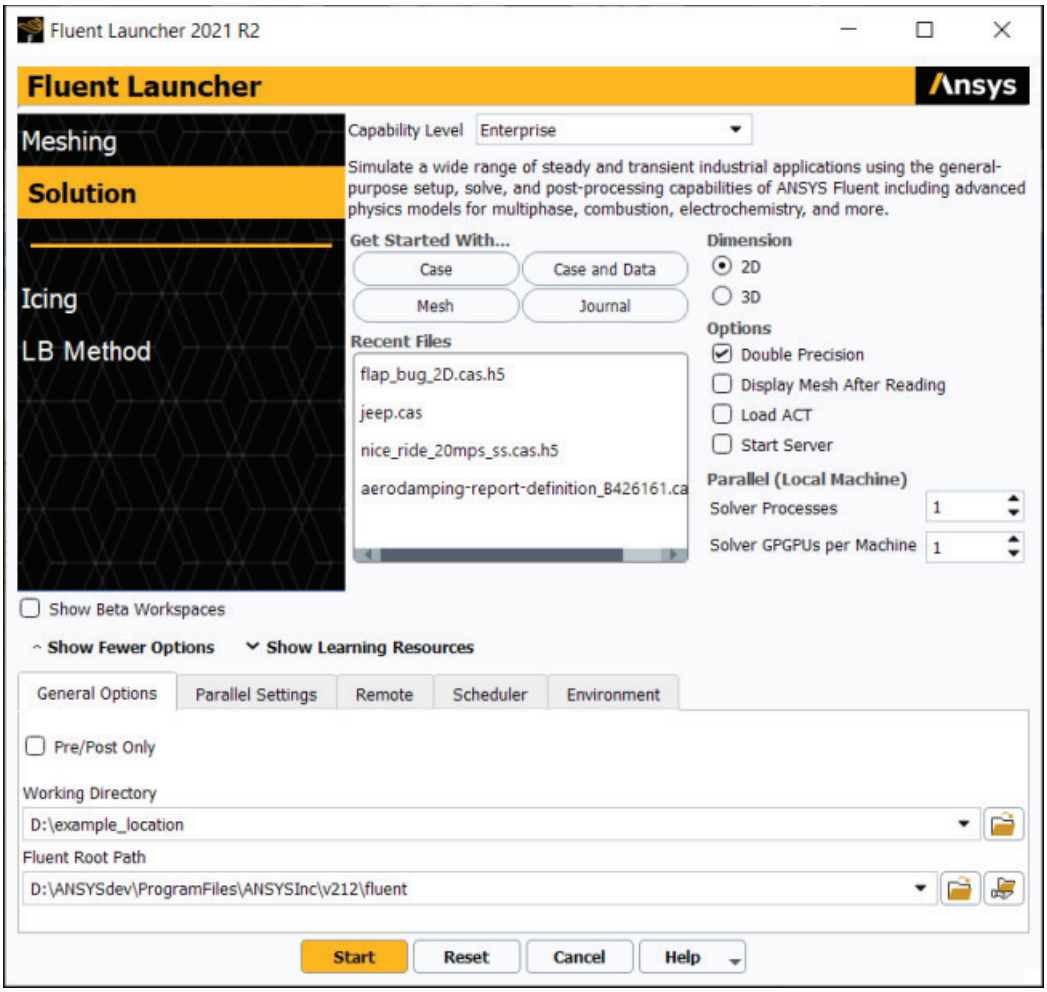
Figure 4.1: The General Options Tab of Fluent Launcher



1. Enable **Pre/Post Only** to run Ansys Fluent with only the setup and postprocessing capabilities available. The default Ansys Fluent full solution mode allows you to set up, solve, and postprocess a problem, while **Pre/Post Only** will not allow you to perform calculations.

2. Specify the path of your current working directory using the **Working Directory** field or click to browse through your directory structure.

Note:

a Uniform Naming Convention (UNC) path cannot be set as a working directory. You need to map a drive to the UNC path (Windows only)

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3. Specify the location of the Ansys Fluent installation on your system using the **Fluent Root Path** field, or click to browse through your directory structure. Try to use the UNC path if applicable.

   Note:

   The button automatically converts a local path to a UNC path if any matching shared directory is found (Windows only). Once set, various fields in Fluent Launcher (for example, parallel settings, etc.) are automatically populated with the available options, depending on the Ansys Fluent installations that are available.

4.1.2.2. Single-Precision and Double-Precision Solvers

Both single-precision and double-precision versions of Ansys Fluent are available on all computer platforms. For most cases, the single-precision solver will be sufficiently accurate, but certain types of problems may benefit from the use of a double-precision version. Several examples are listed below:

- If your geometry has features of very disparate length scales (for example, a very long, thin pipe), single-precision calculations may not be adequate. Note that nodal coordinates are always stored in double precision (even for the single-precision version of Ansys Fluent), so they are not a concern in this regard.
- If your geometry involves multiple enclosures connected via small-diameter pipes (for example, automotive manifolds), mean pressure levels in all but one of the zones can be quite large (since you can set only one global reference pressure location). Double-precision calculations may therefore be necessary to resolve the pressure differences that drive the flow, since these will typically be much smaller than the pressure levels.
- For conjugate problems involving high thermal-conductivity ratios and/or high-aspect-ratio meshes, convergence and/or accuracy may be impaired with the single-precision solver, due to inefficient transfer of boundary information.
- For multiphase problems where the population balance model is used to resolve particle size distributions, which could have statistical moments whose values span many orders of magnitude.

  Note:

  Ansys Fluent allows only a period to be used as a decimal separator. If your system is set to a European locale that uses a comma separator (for example, Germany), fields that accept numeric input may accept a comma, but may ignore everything after the comma. If your system is set to a non-European locale, numeric fields will not accept a comma at all.

  Ansys Workbench accepts commas as decimal delimiters. These are translated into periods when data is passed to Ansys Fluent.

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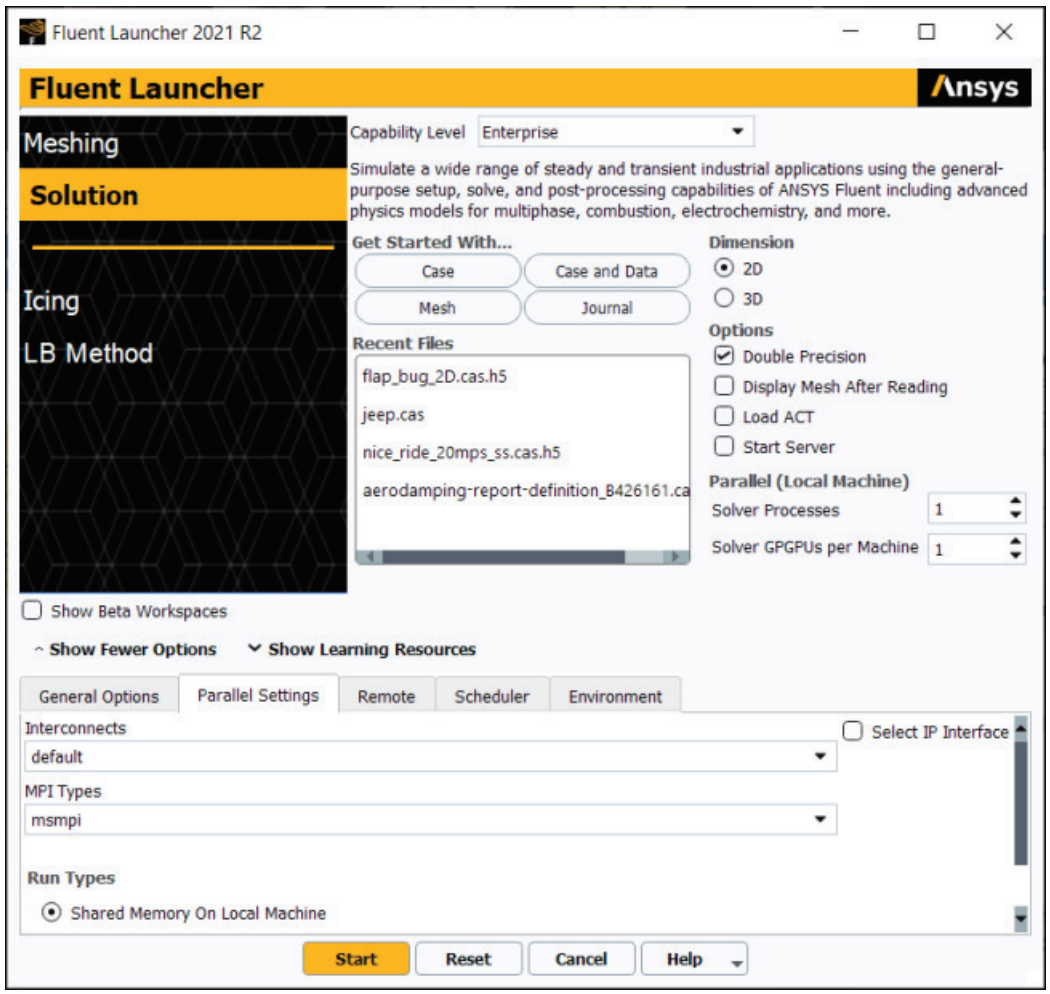
4.1.2.3. Setting Parallel Options in Fluent Launcher

The **Parallel Settings** tab allows you to specify settings for running Ansys Fluent in parallel.

Figure 4.2: The Parallel Settings Tab of Fluent Launcher



1. (**Meshing** workspace only) Enter the number of processes to be used for meshing under **Meshing Processes**.

2. (**Meshing** and **Solution** workspaces only) Enter the number of processes to be used for solution under **Solver Processes**. On Linux with the Intel MPI, additional processes will be spawned as necessary when you change to solution mode, in order to bring the total number of processes to this value; this must be set to a value greater than or equal to **Meshing Processes**. For details on this dynamic spawning, see Dynamically Spawning Processes Between Fluent Meshing and Fluent Solution Modes (p. 202).

3. (**Meshing** and **Solution** workspaces only) If your machine is equipped with General Purpose Graphics Processing Units you can also specify **Solver GPGPUs per Machine**.

Refer to Parallel Processing in the *Fluent User's Guide* (p. 3745) for details on parallel processing using Fluent and Starting Parallel Ansys Fluent Using Fluent Launcher in the *Fluent User's Guide* (p. 3748) for additional details parallel process configuration options on this tab.

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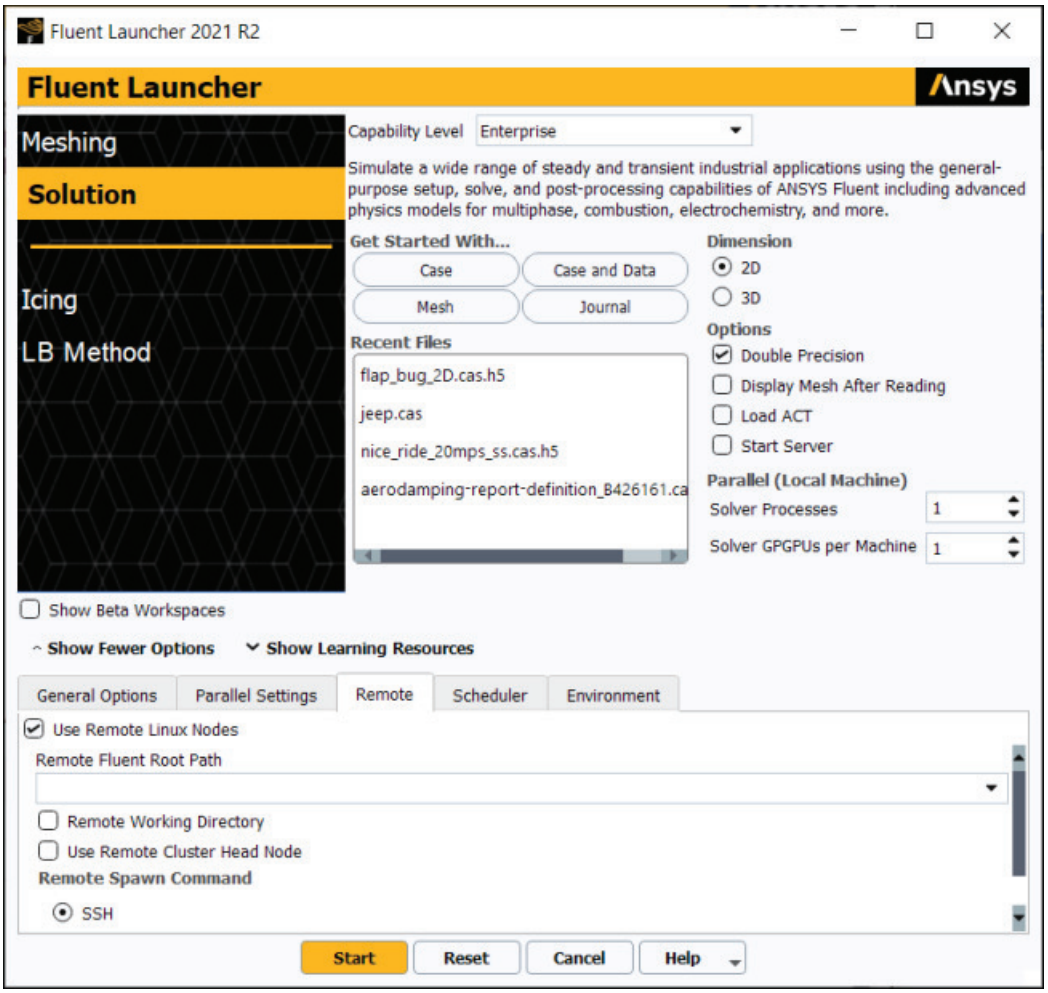
4.1.2.4. Setting Remote Options in Fluent Launcher

The **Remote** tab (Figure 4.3: The Remote Tab of Fluent Launcher (p. 170)) allows you to specify settings for running Ansys Fluent parallel simulations on Linux clusters, via the Windows interface.

Figure 4.3: The Remote Tab of Fluent Launcher



For additional information about this tab, see Setting Additional Options When Running on Remote Linux Machines (p. 3753).

4.1.2.5. Setting Scheduler Options in Fluent Launcher

Enable **Use Job Scheduler** to specify settings in the **Scheduler** tab (Figure 4.4: The Scheduler Tab of Fluent Launcher (Windows 64 Version) (p. 171)) for running Ansys Fluent with various job schedulers (for example, the Microsoft Job Scheduler for Windows, or LSF, SGE, PBS Pro, and Slurm on Linux).

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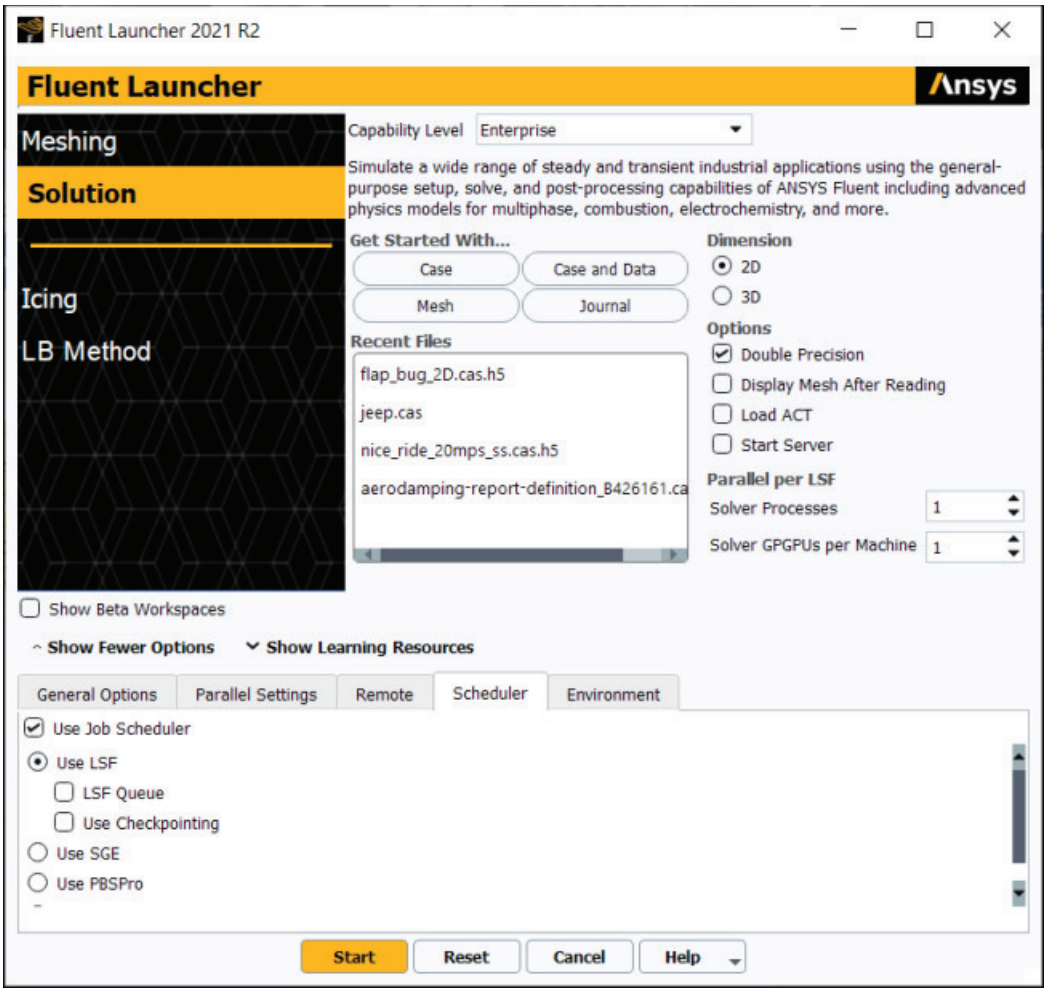
Figure 4.4: The Scheduler Tab of Fluent Launcher (Windows 64 Version)



For additional information about this tab, see Setting Parallel Scheduler Options in Fluent Launcher (p. 3750).

4.1.2.6. Setting Environment Options in Fluent Launcher

The **Environment** tab (Figure 4.5: The Environment Tab of Fluent Launcher (p. 172)) allows you to specify compiler settings for compiling user-defined functions (UDFs) with Ansys Fluent (Windows only). The **Environment** tab also allows you to specify environment variable settings for running Ansys Fluent.

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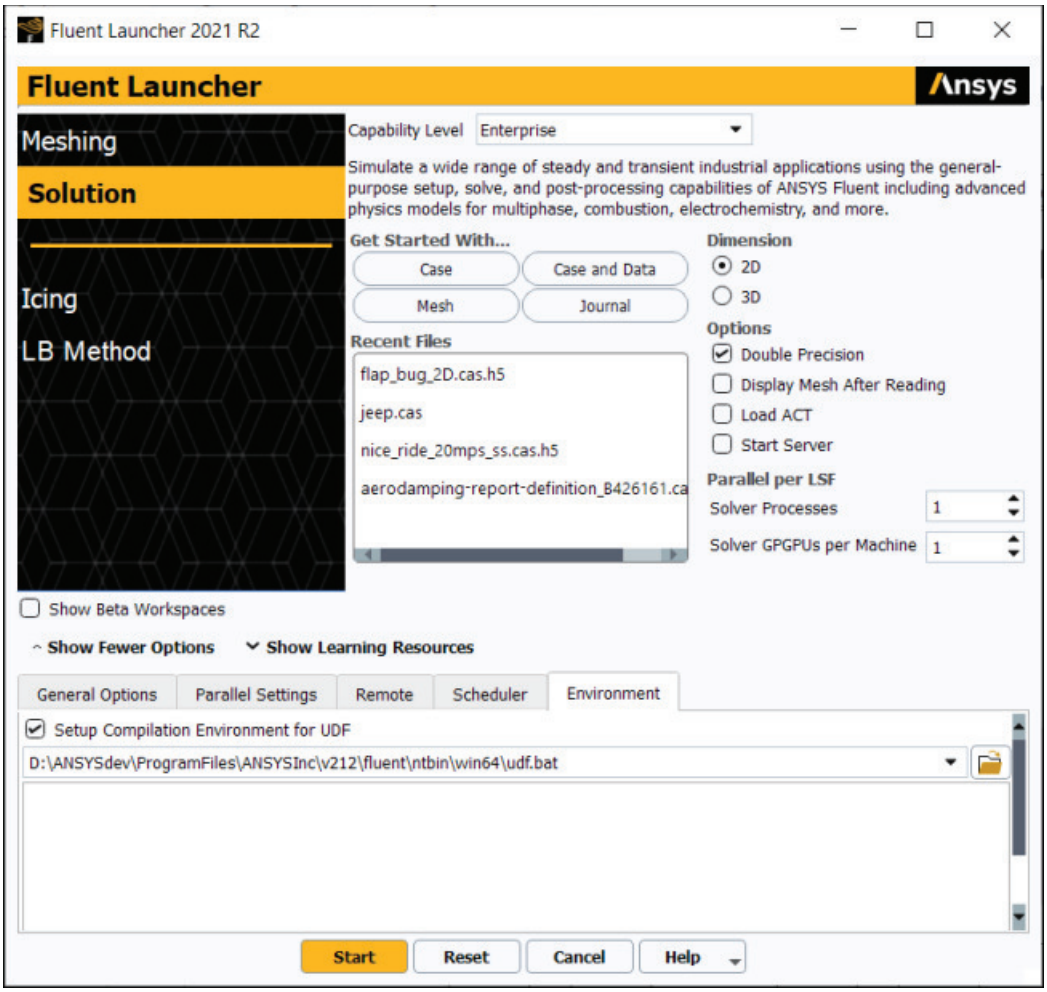
Figure 4.5: The Environment Tab of Fluent Launcher



Specify a batch file that contains UDF compilation environment settings by selecting the **Set up Compilation Environment for UDF** check box (enabled by default). Once selected, you can then enter a batch file name in the text field. By default, Fluent Launcher uses the `udf.bat` file that is located in the directory where Ansys Fluent is installed. It is recommended that you keep the default batch file, which is tested with MS Visual Studio C++ and Clang compilers (for supported versions, see Compiler Requirements for Windows Systems), as well as the built-in compiler (Clang) included with the Fluent installation. For more information about compiling UDFs, see the separate Fluent Customization Manual.

Under **Other Environment Variables**, enter or edit license file or environment variable information in the text field. For example, `FLUENT_AFFINITY=<x>` specifies the process binding (affinity) setting, in the same manner as the `-affinity=<x>` command line option (see Parallel Options (p. 179) for details). Using the **Default** button resets the default value(s).

4.1.3. Starting Ansys Fluent on a Windows System

There are two ways to start Ansys Fluent on a Windows system:

- From the Windows **Start** menu, click **Start > ANSYS 2021 R2 > Fluid Dynamics > Fluent 2021 R2**

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This option starts Fluent Launcher (see Starting Ansys Fluent Using Fluent Launcher (p. 164)). The Fluent Launcher may also be accessed via an icon on your desktop or in the Quick Launch bar.

Note:

If the default "Ansys 2021 R2" program group name was changed when Ansys Fluent was installed, you will find the **Fluent** menu item in the program group with the new name that was assigned, rather than in the **Ansys 2021 R2** program group.

- From a Command Prompt window, type `fluent version`, where `version` is replaced with one of the four options specifying the dimension and precision of the solver.
  - `2d` for the 2D, single-precision solver.
  - `3d` for the 3D, single-precision solver.
  - `2ddp` for the 2D, double-precision solver.
  - `3ddp` for the 3D double-precision solver.

  For additional information on starting Fluent from the command prompt, see Command Line Startup Options (p. 174).

Important:

To be able to start Ansys Fluent from the command prompt, be sure the path to your Ansys Fluent home directory is in your command search path environment variable by executing the `setenv.exe` program located in the Ansys Fluent directory (for example, `C:\Program Files\ANSYS Inc\v212\fluent\ntbin\win64`).

Tip:

You can also specify the number of processors or start Ansys Fluent in meshing mode from the Command Prompt.

- To specify the number of processors, type `fluent version -tx`, replacing `version` with the desired solver version and `x` with the number of processors. For example, `fluent 3d -t4` to run the 3D version on 4 processors.
- To start in meshing mode, add the command line option `-meshing`. For example, `fluent 3d -meshing` to start in meshing mode.
- Both parallel and meshing mode may be combined. You must specify the number of meshing processes using `-tmy`. For example, `fluent 3ddp -meshing -tm4` will start Ansys Fluent in meshing mode with 4 meshing processes. When switched to solution mode, the solver will be 3D, double precision and run 4 processes. It is not possible to switch from meshing mode to solution mode with a different number of processes on Windows, so if you need to run the calculation with a higher number of processes you must start a new session.

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4.1.4. Starting Ansys Fluent on a Linux System

There are two ways to start Ansys Fluent on a Linux system:

- Start Fluent from the command line without specifying a version, and then use Fluent Launcher to choose the appropriate version along with other options. See Starting Ansys Fluent Using Fluent Launcher (p. 164) for details.
- Start the appropriate version from the command line by typing `fluent version`, where `version` is replaced with one of the four options specifying the dimension and precision of the solver.
  - `2d` for the 2D, single-precision solver.
  - `3d` for the 3D, single-precision solver.
  - `2ddp` for the 2D, double-precision solver.
  - `3ddp` for the 3D double-precision solver.

Tip:

You can also specify the number of parallel processors or start Ansys Fluent in meshing mode from the command line.

- To specify the number of processors, type `fluent version -tx`, replacing `version` with the desired solver version and `x` with the number of processors. For example, `fluent 3d -t4` to run the 3D version on 4 processors.
- To start in meshing mode, add the command line option `-meshing`. For example, `fluent 3d -meshing` to start in meshing mode.
- Both parallel and meshing mode may be combined. You must specify the number of meshing processes using `-tmy`. For example, `fluent 3ddp -meshing -tm4 -t8` will start Ansys Fluent in meshing mode with 4 meshing processes. When switched to solution mode, the solver will be 3D, double precision and run 8 processes; note that dynamically spawning additional processes in solution mode is only available on Linux with the default MPI.

Note:

Ansys Fluent automatically selects the best graphics driver and defaults to the X11 driver when it does not detect the required graphics support. You can use the `HOOPS_PICTURE` environment variable to force a particular graphics driver, if you feel it is necessary to use an alternate driver.

4.1.5. Command Line Startup Options

Table 4.1: Available Command Line Options for Linux and Windows Platforms (p. 175) lists the available command line arguments for Linux and Windows. More detailed descriptions of these options can be found in the following sections.

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To obtain information about available startup options, you can type `fluent -help` before starting up Fluent.

Table 4.1: Available Command Line Options for Linux and Windows Platforms

Option	Platform	Description
`-aas`	all	Start Fluent in server mode.
`-act`	all	Load ACT on Fluent startup.
`-affinity=<x>`	all	Specifies the process binding (affinity) setting, as described in Parallel Options (p. 179).
`-app=flremote`	all	Launches the Remote Visualization Client.
`-appscript=<scriptfile>`	all	Runs the specified script in the specified application (must be used with the `-app=<x>` startup option.
`-command="<TUI command>"`	all	Executes the specified text command (`<TUI command>`) at Fluent startup.
`-ccp <x>`	Windows only	Uses the Microsoft Job Scheduler, where `<x>` is the head node name.
`-cflush`	Linux only	Ensures that the file cache buffers are flushed.
`-cnf=<x>`	all	Specifies that `<x>` is the hosts file or (for Linux) machine list.
`-driver <name>`	all	Sets the graphics driver (available drivers vary by platform, and include `opengl`, `opengl2`, `x11`, and `null` for Linux and `opengl`, `opengl2`, `dx11`, `msw`, and `null` for Windows).
`-env`	all	Show environment variables.
`-g`	all	Run without the GUI or graphics.
`-gpgpu=<n>`	Linux and Win64 only	Specifies the number of GPGPUs per machine that should be used for AMG acceleration. Only available in parallel.
`-gr`	all	Run without graphics.
`-gu`	all	Run without the GUI but with graphics. You cannot interact with the displayed graphics objects.
`-gui_machine=<hostname>`	Linux only	Specifies that `<hostname>` is used for running Cortex (the process that manages the GUI and graphics).
`-h<heap size>`	all	Specifies the heap space for Cortex (the process that manages the GUI and graphics)
`-help`	all	Display command line options.

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Option	Platform	Description
-hidden	Windows only	Run in minimized mode.
-host_ip=<host:ip>	all	Specifies that the IP interface <host:ip> is to be used by the host.
-i <journal>	all	Reads the specified journal file(s). Read multiple journals at once as follows: -i example1.jou -i example2.jou -i example3.jou ... *AAS Mode does not support multiple journals from the command line.*
-meshing	all	Start Fluent in meshing mode (you must specify Fluent as either 3d or 3ddp).
-mpi=<mpi>	all	Specifies that the MPI implementation is <mpi> (for example, intel).
-mpitest	all	Launches an MPI program to collect network performance data and prints to console (Linux) or to the working directory (Windows).
-nm	all	Do not display mesh after reading.
-p<ic>	all	Specify interconnect; <ic>={default | eth | ib}
-pcheck	Linux only	Check the network connections before spawning compute nodes.
-platform=<x>	Linux only	Loads a binary that is specially ported for a particular platform, as described in Performance Options (p. 179).
-post	all	Run the Ansys Fluent postprocessing-only executable.
-r	all	List all releases installed in the current directory.
-r<x>	all	Run release <x> of Ansys Fluent.
-remote_node=<hostname>	Linux only	Specify the machine to be used for executing mpirun to launch the node processes; if =<hostname> is omitted, the first node in the hosts file will be used.
-scheduler=<scheduler>	Linux only	Run Ansys Fluent under a scheduler; <scheduler> can be set to lsf (LSF), pbs (PBS Professional), sge (Univa Grid Engine—formerly Sun Grid Engine), or slurm (Slurm).

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Option	Platform	Description
-scheduler_account=<account>	Linux only	Specifies that the account is set to <account> when running under Slurm.
-scheduler_custom_script	Linux only	Ensures the use of environment variables when using custom scheduler scripts.
-scheduler_headnode=<head-node>	Linux only	Specifies the scheduler job submission machine name.
-scheduler_opt=<opt>	Linux only	Enables an additional option <opt> that is relevant for the selected scheduler; this command line option can be included multiple times.
-scheduler_pe=<pe>	Linux only	Sets the parallel environment to <pe> when running under SGE.
-scheduler_queue=<queue>	Linux only	Sets the scheduler queue or partition to <queue>.
-scheduler_stderr=<err-file>	Linux only	Sets the scheduler standard error file to <err-file>.
-scheduler_stdout=<out-file>	Linux only	Sets the scheduler standard output file to <out-file>.
-scheduler_tight_coupling	Linux only	Enables a job-scheduler-supported native remote node access mechanism.
-setenv="<var>=<value>"	all	Sets the environment variable <var> to <value>.
-sifile=<name>.txt	all	Run Ansys Fluent and start the remote visualization server. *You can provide a path before the server info filename to specify where the file is created.*
-stream	Linux only	Prints the memory bandwidth.
-t<x>	all	Specifies that the number of processors is <x>.
-tm<x>	all	Specifies that the number of processors for meshing is <x>.

4.1.5.1. ACT Option

`fluent -act` loads Ansys ACT at Fluent startup. For additional information about ACT in Fluent, see Customizing Fluent in the *Fluent User's Guide* (p. 3983).

4.1.5.2. Application Option

`fluent -app=flremote` launches either the Fluent Launcher or the specified dimension of Fluent (for example, 3ddp), along with the Fluent Remote Visualization Client. For additional information about the Fluent Remote Visualization Client, refer to Remote Visualization and Accessing Fluent Remotely (p. 4945).

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4.1.5.3. Application Script Option

`fluent -appscript`, allows you to specify a script that will run in the specified application (`-appscript` must be used in conjunction with `-app`).

4.1.5.4. Graphics Options

Note:

Fluent automatically selects the best graphics driver for the given runtime environment, unless you choose a specific graphics driver with the `fluent -driver` command line option.

(Windows only) The `OpenGL` graphics driver is deprecated and in some instances may cause Ansys Fluent to close unexpectedly. It is recommended that you have a good supported graphics card to ensure the best performance.

`fluent -driver` allows you to specify the graphics driver to be used in the session. When enabling graphics display, you have various options: on Linux, the available drivers include `fluent -driver opengl2`, `fluent -driver opengl`, and `fluent -driver x11`; on Windows, the available drivers include `fluent -driver opengl2`, `fluent -driver opengl`, `fluent -driver dx11`, and `fluent -driver msw` (the latter instructs Ansys Fluent to use the Operating Systems Windows driver). For both Linux and Windows, you can disable graphics display using `fluent -driver null`. For a comprehensive list of the drivers available to you, open a Fluent session, enter the `display/set/rendering-options/driver` text command, and then press the **Enter** key at the `driver>` prompt. For more details about using the driver options, see Hiding the Graphics Window Display (p. 3456) in the User's Guide (p. 1).

Note:

For any session that displays graphics in a graphics window and/or saves picture files, having the driver set to `x11`, `msw`, or `null` will cause the rendering / saving speed to be significantly slower.

`fluent -gui_machine=<hostname>` will run Cortex on a specified machine (`<hostname>`). This option is only available when running on Linux, and may be needed to ensure optimal graphics performance when running Fluent under a scheduler / load manager (using the `-scheduler=<scheduler>` option, as described in Scheduler Options (p. 181)).

Important:

(Exceed onDemand Only) When you are using the `-gui_machine` flag you must also use `-setenv="CORTEX_PRE=ssrun"` to specify the server side rendering to ensure accelerated graphics performance.

For example: `fluent 3ddp -t2 -setenv="CORTEX_PRE=/opt/Exceed_connection_server_13.8_64/bin/ssrun" -scheduler=<scheduler> -scheduler_queue=<queue> -gui_machine=<hostname>`

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Note that the path to `ssrun` may be different for your specific environment.

`fluent -g` will run Cortex without graphics and without the graphical user interface. This option is useful if want to submit a batch job.

`fluent -gr` will run Cortex without graphics. This option can be used in conjunction with the `-i <journal>` option to run a job in "background" mode.

`fluent -gu` will run Cortex without the graphical user interface but will open graphics windows and display graphics objects. You cannot interact with the displayed graphics objects.

To start Fluent and immediately read a journal file, type `fluent -i <journal>`, replacing `<journal>` with the name of the journal file you want to read.

`fluent -h<heap size>` will update the heap space for Cortex processes to the specified size. For example, `fluent 3ddp -h50000000`. The default heap size is `6000000`.

`fluent -nm` will run Cortex without displaying the mesh in the graphics window.

Important:

Download graphics card driver updates directly from the graphics card vendor's website, for example www.nvidia.com. Do not use the "Update Driver" feature offered by the operating system as these can sometimes update to an older version of the driver.

4.1.5.5. Meshing Mode Option

`fluent -meshing` specifies that Fluent opens in meshing mode rather than the default solution mode. See the Fluent User's Guide (p. 1) for further details about the meshing mode.

4.1.5.6. Performance Options

`-cflush` specifies that memory is allocated in such a way as to ensure that all of the associated file cache buffers are flushed. This may resolve processing performance issues. For more details, see Clearing the Linux File Cache Buffers (p. 3803) in the User's Guide (p. 1).

`-platform=<x>` loads a binary that is specially ported for a particular platform. When `<x>=intel`, an AVX2 optimized binary is used that enhances performance when running on processors that support the AVX2 instruction set (available only on Linux).

`-stream` prints the memory bandwidth, using a variant of the STREAM benchmark. This information can be helpful in determining if your memory is set up in an optimal manner.

4.1.5.7. Parallel Options

These options are used in association with the parallel solver.

`-affinity=<x>` specifies the process binding (affinity) settings. The default behavior depends upon the platform on which you are running:

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- When running on Linux, there are two options available:
  - If <x> = core, each process is assigned to an individual core in an optimized manner. This is the default for when running in exclusive mode, that is, when the machine is not already loaded.
  - If <x> = sock, processes are assigned to all cores in sockets rather than the individual cores. This is the default for when running in non-exclusive mode.
- When running on Windows, the default behavior depends upon the selected message passing interface (MPI).
  - For the Intel MPI (which is the default), Fluent by default allows Intel MPI to manage process binding. You can set -affinity=1 to use Fluent-managed affinity, which assigns each process to an individual core.
  - For the Microsoft MPI (which is the default when running under the Microsoft Job Scheduler), the scheduler itself manages process binding by default. Whereas, when the Microsoft MPI is selected for shared memory runs, Fluent by default assigns each process to an individual core.
- If <x> = off, the Fluent-managed affinity settings are disabled for both platforms (Windows and Linux).

-ccp <x> (where <x> is the name of the head node) runs the parallel job through the Microsoft Job Scheduler as described in Starting Parallel Ansys Fluent with the Microsoft Job Scheduler (p. 3760) in the User's Guide (p. 1).

-cnf=<x> (where <x> is the name of a hosts file or a list of Linux machines) spawns a compute node on each of the specified machines. For details, see Starting Parallel Ansys Fluent on a Windows System Using Command Line Options (p. 3758) or Starting Parallel Ansys Fluent on a Linux System Using Command Line Options (p. 3763) in the User's Guide (p. 1).

-gpgpu=<n> specifies the number of general purpose graphics processing units (GPGPUs) per machine to be used for AMG acceleration. For more information, see Using General Purpose Graphics Processing Units (GPGPUs) With the Algebraic Multigrid (AMG) Solver in the *Fluent User's Guide* (p. 3794).

-host_ip=<host:ip> specifies the IP interface to be used by the host process.

-mpi=<mpi> specifies that <mpi> is to be used for the MPI. You can skip this flag if you choose to use the default MPI.

-mpiopt=<x> allows you to specify any additional MPI flags (<x>) to be included in the run (Linux only).

-mpitest runs the mpitest program instead of Ansys Fluent to test the network.

-p<ic> specifies the use of parallel interconnect <ic>, where <ic> can be any of the interconnects listed in Starting Parallel Ansys Fluent on a Windows System Using Command Line Options (p. 3758) or Starting Parallel Ansys Fluent on a Linux System Using Command Line Options (p. 3763) in the User's Guide (p. 1).

-pcheck checks the network connections before spawning compute nodes (Linux only).

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By default, the mpirun command (which launches the node processes) is executed on the compute node where the host process is spawned. You can use `-remote_node=<hostname>` to specify a different machine for the execution of this command. If `=<hostname>` is omitted, the first node in the hosts file will be used. (Linux only)

`-ssh` specifies that SSH should be used to spawn remote processes. (Beginning with Ansys Fluent R16.0, SSH is used by default. This option is included primarily for backward compatibility with existing launch scripts, etc.)

`-t<x>` specifies that `<x>` processors are to be used. For more information about starting the parallel version of Ansys Fluent, see Starting Parallel Ansys Fluent on a Windows System (p. 3758) or Starting Parallel Ansys Fluent on a Linux System (p. 3763) in the User's Guide (p. 1).

`-tm<x>` specifies that `<x>` processors are to be used for meshing. This value must be less than or equal to the number of processes specified with `-t<x>`.

4.1.5.8. Postprocessing Option

`fluent -post` will run a version of Fluent that allows you to set up a problem or perform postprocessing, but will not allow you to perform calculations. Running Ansys Fluent for pre- and postprocessing requires you to use the `-post` flag on startup. To use this option on Linux, launch Ansys Fluent by adding the `-post` flag after the version number, for example,

```
fluent 3d -post
```

To use this same feature from the graphical interface on Windows or Linux, select the **Pre/Post** option in the **General** tab of Fluent Launcher, as described in Starting Ansys Fluent Using Fluent Launcher (p. 164).

4.1.5.9. Remote Visualization Options

The `-sifile=<name>.txt` option starts Ansys Fluent and the server that is necessary for running the remote visualization client. For additional information on remote visualization, refer to Remote Visualization and Accessing Fluent Remotely (p. 4945).

Note:

You can specify the location for the server info file prior to the filename, for example `-sifile=D:/example_folder/server_info_example_name.txt`. If you do not provide a file path before the file name and you do not provide a path using the `SERVER_INFO_DIR` environment variable, then the file is saved in your working directory.

4.1.5.10. Scheduler Options

The `-scheduler=<scheduler>` option allows you to specify that your Linux session is run under a scheduler / load manager, where `<scheduler>` can be one of the following:

- `lsf`: this allows you to run Ansys Fluent under IBM Spectrum LSF software, and thereby take advantage of the checkpointing features of that load management tool. For further details, see Part 1: Running Fluent Under LSF.

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- `pbs`: this runs Ansys Fluent under Altair PBS Professional, and allows you to use the features of this software to manage your distributed computing resources. For further details, see Part 2: Running Fluent Under PBS Professional.
- `sge`: this runs Ansys Fluent under Univa Grid Engine (previously known as Sun Grid Engine, or SGE) software, and allows you to use the features of this software to manage your distributed computing resources. For further details, see Part 3: Running Fluent Under SGE.
- `slurm`: this runs Ansys Fluent under Slurm, and allows you to use the features of this software to manage your distributed computing resources. For further details, see Part 4: Running Fluent Under Slurm.

Note:

You can use the `-scheduler=<scheduler>` option along with the `-gui_machine=<hostname>` (described in Graphics Options (p. 178)), in order to ensure optimal graphics performance. When running under Slurm, the `-gui_machine=<hostname>` is also needed to allow dynamic spawning (which is described in Dynamically Spawning Processes Between Fluent Meshing and Fluent Solution Modes (p. 202)), as well as the combination of Slurm + Open MPI + distributed memory on a cluster.

If you use custom scheduler scripts instead of relying on the standard Fluent option (`-scheduler=<scheduler>`), your environment variables related to the job scheduler will not be used unless you include the `-scheduler_custom_script` option with the Fluent options in your script.

Other options are available when you use a scheduler: you can specify the scheduler job submission machine name using `-scheduler_headnode=<head-node>` (by default it is `localhost`); you can specify a queue / partition using `-scheduler_queue=<queue>`; you can enable an additional option for the scheduler using `-scheduler_opt=<opt>` (note that you can include multiple instances of this option when you want to use more than one scheduler option); you can specify the name and directory of the scheduler standard error file using `-scheduler_stderr=<err-file>` (by default it is saved as `fluent.<PID>.e` in the working directory, where `<PID>` is the process ID of the top-level Fluent startup script); you can specify the name and directory of the scheduler standard output file using `-scheduler_stdout=<out-file>` (by default it is saved as `fluent.<PID>.o` in the working directory); when running under Univa Grid Engine software, you can set the parallel environment using `-scheduler_pe=<pe>`; and when running under Slurm you can set the account using `-scheduler_account=<account>`.

It is also possible to enable a job-scheduler-supported native remote node access mechanism using `-scheduler_tight_coupling` in Linux. For details about the MPI / job scheduler combinations that are supported for this tight coupling, see Running Fluent Using a Load Manager.

4.1.5.11. Text Command Option

The `-command="<TUI command>"` option allows you to specify that a single text command (`<TUI command>`) is executed at Fluent startup. The text command must be complete, that is, it cannot rely on further user input in the console after launching. Up to 10 instances of this option can be included, and the text commands will be executed in the order they are entered. When this option is used along with the `-i <journal>` option, the text commands are executed before the journal.

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For example, you could enter the following to read a case and start a calculation: `fluent 3d -command="file/read-case file_name.cas" -command="solve/initialize/initialize-flow" -command="sol iter 10"`.

4.1.5.12. Version, Release Options, and Environment Variables

Typing `fluent <version> -r`, replacing `<version>` with the desired version (`2d` or `3d`, or for double precision, `fluent` or `3ddp`), will list all releases of the specified version.

`fluent -r<x>` will run release `<x>` of Ansys Fluent.

Typing `fluent <version> -env`, replacing `<version>` with the desired version, will list all environment variables before running Ansys Fluent.

Including the `-setenv="<var>=<value>"` option sets the environment variable `<var>` explicitly to `<value>` before launching Ansys Fluent. Note that you can include as many instances of this option as you need to set all of the relevant environment variables. You can also unset an environment variable by entering `-setenv="<var>="`.

4.1.5.13. System Coupling Options

The following command line options (in either Windows or Linux) can be used when Ansys Fluent is involved in a system coupling simulation.

`-schost="<x>"` (where `<x>` is the name of the host machine, in quotes) specifies the host machine on which the coupling service is running (to which the co-simulation participant/solver must connect).

`-scport=<y>` (where `<y>` is the port number) specifies the port on the host machine upon which the coupling service is listening for connections from co-simulation participants.

`-scname="<z>"` (where `<z>` is the name of the participant, in quotes) specifies the unique name used by the co-simulation participant to identify itself to the coupling service (see Server File (`scServer.scs`) in the *System Coupling User's Guide* for more information).

The general syntax for invoking Ansys Fluent for system coupling is:

`fluent 3d –schost=`*host name in quotes* `–scport=`*port number* `–scname=`*name of the solver in quotes*

For instance:

```
fluent 3d –schost="machine1.domain.com" –scport=1234 –scname="Solution1"
```

Once Ansys Fluent loads the case, initialize the solution using the following command:

```
s i i
```

Once your case is initialized, start the system coupling by typing the following command in the Ansys Fluent text user interface (TUI):

```
(sc-solve)
```

For more information, see Performing System Coupling Simulations Using Fluent (p. 3951) in the Fluent User's Guide, as well as the System Coupling User's Guide.

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4.1.5.14. Other Startup Options

There are other startup options that are not listed when you type the `fluent -help` command. These options can be used to customize your graphical user interface. For example, to change the Ansys Fluent window size and position you can either modify the .Xdefaults file described in Customizing the Graphical User Interface (p. 830) in the User's Guide (p. 1), or you can simply type the following command at startup:

```
fluent <version> -geometry <XX>x<YY>+<xx>-<yy>
```

where `<XX>` and `<YY>` are the width and height in pixels, respectively, and `+<xx>-<yy>` is the position of the window.

Therefore, typing `fluent 3d -geometry 700x500+20-400` will start the 3D version of Ansys Fluent, sizing the Ansys Fluent console to 700x500 pixels and positioning it on your monitor screen at +20-400.

There are additional Qt command line startup options for modifying the graphical stylesheet and more, which can be found in Qt documentation.

4.2. Running Ansys Fluent in Batch Mode

Ansys Fluent can be used interactively, with input from and display to your computer screen, or it can be used in a batch or background mode in which inputs are obtained from and outputs are stored in files. Generally you will perform problem setup, initial calculations, and postprocessing of results in an interactive mode. However, when you are ready to perform a large number of iterative calculations, you may want to run Ansys Fluent in batch or background mode. This allows the computer resources to be prioritized, enables you to control the process from a file (eliminating the need for you to be present during the calculation), and also provides a record of the calculation history (residuals) in an output file. While the procedures for running Ansys Fluent in a batch mode differ depending on your computer operating system, Background Execution on Linux Systems (p. 184) provides guidance for running in batch/background on Linux systems, and Background Execution on Windows Systems (p. 186) provides guidance for running in batch/background on Windows systems.

For additional information, see the following sections:

4.2.1. Background Execution on Linux Systems

4.2.2. Background Execution on Windows Systems

4.2.3. Batch Execution Options

4.2.1. Background Execution on Linux Systems

To run Ansys Fluent in the background in a C-shell (csh) on a Linux system, type a command of the following form at the system-level prompt:

```
fluent 2d -g < inputfile > & outputfile &
```

or in a Bourne/Korn-shell, type:

```
fluent 2d -g < inputfile > outputfile 2>&1 &
```


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In these examples,

- `fluent` is the command you type to run Ansys Fluent interactively.
- `-g` indicates that the program is to be run without the GUI or graphics (see Starting Ansys Fluent (p. 163)).
- `inputfile` is a file of Ansys Fluent commands that are identical to those that you would type interactively.
- `outputfile` is a file that the background job will create, which will contain the output that Ansys Fluent would normally print to the screen (for example, the menu prompts and residual reports).
- `&` tells the Linux system to perform this task in background and to send all standard system errors (if any) to `outputfile`.

The file `inputfile` can be a journal file created in an earlier Ansys Fluent session, or it can be a file that you have created using a text editor. In either case, the file must consist only of text interface commands (since the GUI is disabled during batch execution). A typical `inputfile` is shown below:

```
; Read case file
rc example.cas
; Initialize the solution
/solve/initialize/initialize-flow
; Calculate 50 iterations
it 50
; Write data file
wd example50.dat
; Calculate another 50 iterations
it 50
; Write another data file
wd example100.dat
; Exit Fluent
exit
yes
```

This example file reads a case file `example.cas`, initializes the solution, and performs 100 iterations in two groups of 50, saving a new data file after each 50 iterations. The final line of the file terminates the session. Note that the example input file makes use of the standard aliases for reading and writing case and data files and for iterating. (`it` is the alias for `/solve/iterate`, `rc` is the alias for `/file/read-case`, `wd` is the alias for `/file/write-data`, etc.) These predefined aliases allow you to execute commonly used commands without entering the text menu in which they are found. In general, Ansys Fluent assumes that input beginning with a `/` starts in the top-level text menu, so if you use any text commands for which aliases do not exist, you must be sure to type in the complete name of the command (for example, `/solve/initialize/initialize-flow`). Note also that you can include comments in the file. As in the example above, comment lines must begin with a `;` (semicolon).

An alternate strategy for submitting your batch run, as follows, has the advantage that the `outputfile` will contain a record of the commands in the `inputfile`. In this approach, you would submit the batch job in a C-shell using:

```
fluent 2d -g -i inputfile  >& outputfile &
```

or in a Bourne/Korn-shell using:

```
fluent 2d -g -i inputfile > outputfile 2>&1 &
```

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4.2.2. Background Execution on Windows Systems

To run Ansys Fluent in the background on a Windows system, the following commands can be used:

```
fluent 3d -g -i journal

fluent 3d -g -wait -i journal

fluent 3d -hidden -i journal
```

In these examples,

- `fluent` is the command you type to run Ansys Fluent interactively.
- `-g` indicates that the program is to be run minimized in the task bar.
- `-i journal` reads the specified journal file.
- `-wait` is the command you type in a DOS batch file or some other script in a situation where the script must wait until Ansys Fluent has completed its run.
- `-hidden` is similar to the `-wait` command, but also runs Ansys Fluent completely hidden and non-interactively.

To get an output (or transcript) file while running Ansys Fluent in the background on a Windows system, the journal file must contain the following command to write a transcript file:

```
; start transcript file
 /file/start-transcript outputfile.trn
```

where the `outputfile` is a file that the background job will create, which will contain the output that Ansys Fluent would normally print to the screen (for example, the menu prompts and residual reports).

See Creating and Reading Journal Files (p. 861) in the User's Guide (p. 1) for details about journal files. See Creating Transcript Files (p. 865) in the User's Guide (p. 1) for details about transcript files.

4.2.3. Batch Execution Options

During a typical session, Ansys Fluent may require feedback from you in the event of a problem it encounters. Ansys Fluent usually communicates problems or questions through the use of **Error** dialog boxes, **Warning** dialog boxes, or **Question** dialog boxes. While executing Ansys Fluent in batch mode, you may want to suppress this type of interaction in order to, for example, create journal files more easily.

There are three common batch configuration options available to you when running Ansys Fluent in batch mode. You can access these options using the **Batch Options** dialog box (Figure 4.6: The Batch Options Dialog Box (p. 187)).

File → Batch Options...

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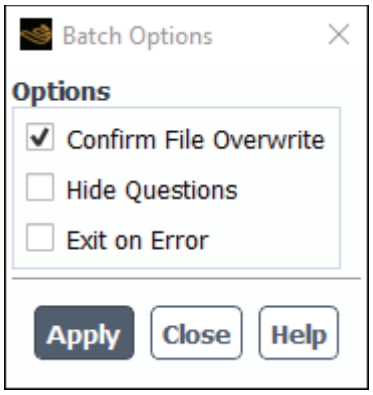
Figure 4.6: The Batch Options Dialog Box



The **Batch Options** dialog box contains the following items:

Confirm File Overwrite

determines whether Ansys Fluent confirms a file overwrite. This option is turned on by default.

Hide Questions

allows you to hide **Question** dialog boxes. This option is turned off by default.

Exit on Error

allows you to automatically exit from batch mode when an error occurs. This option is disabled by default.

When run in batch mode through the command prompt or a journal file with **Exit on Error** enabled, Fluent will exit under the following circumstances:

- Normal run termination upon reaching the end of a journal (return value `0`)
- Error returned during scripted text command execution (return value `1`)
- Unexpected input (wrong type) to text command (return value `1`)
- Licensing error (return value `2`)

If an invalid text command is entered, Fluent will not exit, but proceed to the next text input.

Note that in Windows you must start Fluent with the `-wait` command line option.

`file` → `set-batch-options`

Any combination of these options can be turned on or off at any given time prior to running in batch mode.

Important:

Batch option settings are *not* saved with case files. They are meant to apply for the duration of the current Ansys Fluent session only. If you read in additional mesh or case files during

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this session, the batch option settings will not be altered. As batch options are not saved with case files, journal files developed for use in batch mode should begin by enabling the desired batch option settings (if different from the default settings).

4.3. Switching Between Meshing and Solution Modes

You can switch from the meshing mode of Fluent to the solution mode by clicking the **Switch to Solution** button, located by default in the top left corner of the application window. The mesh from your meshing mode session will be transferred and read in the new solution mode session.

You can switch from the solution mode of Fluent to the meshing mode by using the `switch-to-meshing-mode` text command. Note that this text command is only available for 3D sessions, before you have read a mesh or case file.

Note:

When you read a non-conformal interface case file into meshing mode and later switched to the solution mode, note the following limitations:

- Zone ids may match, however, the corresponding zone names may be inconsistent.
- Boundary conditions on intersected threads are not preserved.
- Unassociated (dangling) non-conformal interface (NCI) surfaces remain present.

4.4. Checkpointing an Ansys Fluent Simulation

The checkpointing feature of Ansys Fluent allows you to save case and data files while your simulation is running. While similar to the autosave feature of Ansys Fluent (Automatic Saving of Case and Data Files (p. 854) in the User's Guide (p. 1)), which allows you to save files throughout a simulation, checkpointing allows you slightly more control in that you can save an Ansys Fluent job even after you have started the job and did not set the autosave option. Checkpointing also allows you to save case and data files and then exit out of Ansys Fluent. This feature is especially useful when you need to stop an Ansys Fluent job abruptly and save its data.

There are two different ways to checkpoint an Ansys Fluent simulation, depending upon how the simulation has been started.

1. Ansys Fluent running under LSF or SGE

   Ansys Fluent is integrated with load management tools like LSF and SGE. These two tools allow you to checkpoint any job running under them. You can use the standard method provided by these tools to checkpoint the Ansys Fluent job.

   For more information on using Ansys Fluent and SGE or LSF, see Part 3: Running Fluent Under SGE or Part 1: Running Fluent Under LSF, respectively.

2. Independently running Ansys Fluent

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When not using tools such as LSF or SGE, a different checkpointing mechanism can be used when running an Ansys Fluent simulation. You can checkpoint an Ansys Fluent simulation while iterating/time-stepping, so that Ansys Fluent saves the case and data files and then continues the calculation, or so that Ansys Fluent saves the case and data files and then exits.

- Saving case and data files and continuing the calculation:

  On Linux, create a file called `check-fluent`, that is,

  ```
  /tmp/check-fluent
  ```

  On Windows, create a file called `check-fluent.txt`, that is,

  ```
  C:\temp\check-fluent.txt
  ```

- Saving case and data files and exiting Ansys Fluent:

  On Linux, create a file called `exit-fluent`, that is,

  ```
  /tmp/exit-fluent
  ```

  On Windows, create a file called `exit-fluent.txt`, that is,

  ```
  C:\temp\exit-fluent.txt
  ```

The saved case and data files will have the current iteration number appended to their file names.

Ansys Fluent offers an alternate way to checkpoint an unsteady simulation. While the default behavior is to checkpoint the simulation at the end of the current iteration, for unsteady simulations you have the option of completing all of the iterations in the current time-step before checkpointing. This can be set by entering the following Scheme command prior to running the unsteady simulation:

```
(ckpt/time-step? #t)
```

Now when you save the checkpoint file (as described previously), the case and data file will be saved at the end of the current time step and named accordingly. To switch back to the default checkpointing mechanism at the end of the current iteration, use the following Scheme command:

```
(ckpt/time-step? #f)
```

Important:

Note that the `(ckpt/time-step? #t)` command will have the effect only in the case of an unsteady simulation.

Note:

It is recommended that you do *not* use checkpointing when using Ansys Fluent in Workbench. However, if checkpointing is necessary, the `exit-fluent/exit-fluent.txt` file can be used and the file will be checked in its default location (the `FFF/FLU` system directory

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containing the `*.set` file). If Ansys Fluent is calculating, then the existence of the file is equivalent to an **interrupt** command. Similarly, the `check-fluent/check-fluent.txt` file can be used to save the project on demand when Ansys Fluent is calculating.

4.5. Cleaning Up Processes From an Ansys Fluent Simulation

Ansys Fluent lets you easily remove extraneous processes in the event that an Ansys Fluent simulation must be stopped.

When a session is started, Ansys Fluent creates a `cleanup-fluent` script file. The script can be used to clean up all Ansys Fluent-related processes. Ansys Fluent creates the cleanup-script file in the current working directory with a filename that includes the machine name and the process identification number (PID) (for example, `cleanup-fluent-mymachine-1234`).

If the current directory does not possess the proper write permissions, then Ansys Fluent will write the cleanup-script file to your home directory.

If, for example, Ansys Fluent is started on a machine called `thor` and the process identification number is `32895`, Ansys Fluent will create a cleanup-script called `cleanup-fluent-thor-32895` in the current directory. To run the cleanup-script, and clean up all Ansys Fluent processes related to your session, on Linux platforms, type the following command in the console window:

```
sh cleanup-fluent-thor-32895
```

Or, if the shell script already has executable permissions, simply type:

```
cleanup-fluent-thor-32895
```

To clean up extraneous Ansys Fluent processes on Windows (serial or parallel), double-click the corresponding batch file (for example, `cleanup-fluent-thor-32895.bat`) that Ansys Fluent generates at the beginning of each session.

Important:

During a normal run, this file will be deleted automatically after exiting Ansys Fluent. In abnormal situations, you may use this batch file to clean up the Ansys Fluent processes. Once an Ansys Fluent session has been closed, you can safely delete any left over cleanup scripts from your working directory.

Important:

If an Ansys Fluent session hangs or freezes on Windows, and you want to view the complete contents of the Ansys Fluent console output in a transcript file, you should use the `taskkill` command through the DOS command prompt, rather than terminating the Ansys Fluent application through the **Windows Task Manager**.

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4.6. Exiting Ansys Fluent

You can exit Ansys Fluent by selecting **Exit** in the **File** ribbon tab. If the present state of the program has not been written to a file, a **Question** dialog box will open to confirm if you want to proceed. You can cancel the exit and write the appropriate file(s) or you can continue to exit without saving the case or data.

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Glossary of Terms

This glossary contains a listing of terms commonly used throughout the documentation.

- adaption (p. 193)
- case files (p. 193)
- cell types (p. 194)
- computational fluid dynamics (CFD) (p. 194)
- console (p. 195)
- convergence (p. 195)
- cortex (p. 195)
- data files (p. 195)
- dialog boxes (p. 195)
- discretization (p. 195)
- GUI (p. 195)
- mesh (p. 195)
- models (p. 195)
- node (p. 195)
- postprocessing (p. 195)
- residuals (p. 195)
- skewness (p. 196)
- solvers (p. 196)
- terminal emulator (p. 196)
- TUI (p. 196)

adaption

A technique useful in improving overall mesh quality. The solution-adaptive mesh refinement feature of Ansys Fluent allows you to refine and/or coarsen your mesh based on geometric and numerical solution data. In addition, Ansys Fluent provides tools for creating and viewing adaption fields customized to particular applications.

case files

Files that contain the mesh, boundary conditions, and solution parameters for a problem. A case file also contains the information about the user interface and graphics environment.

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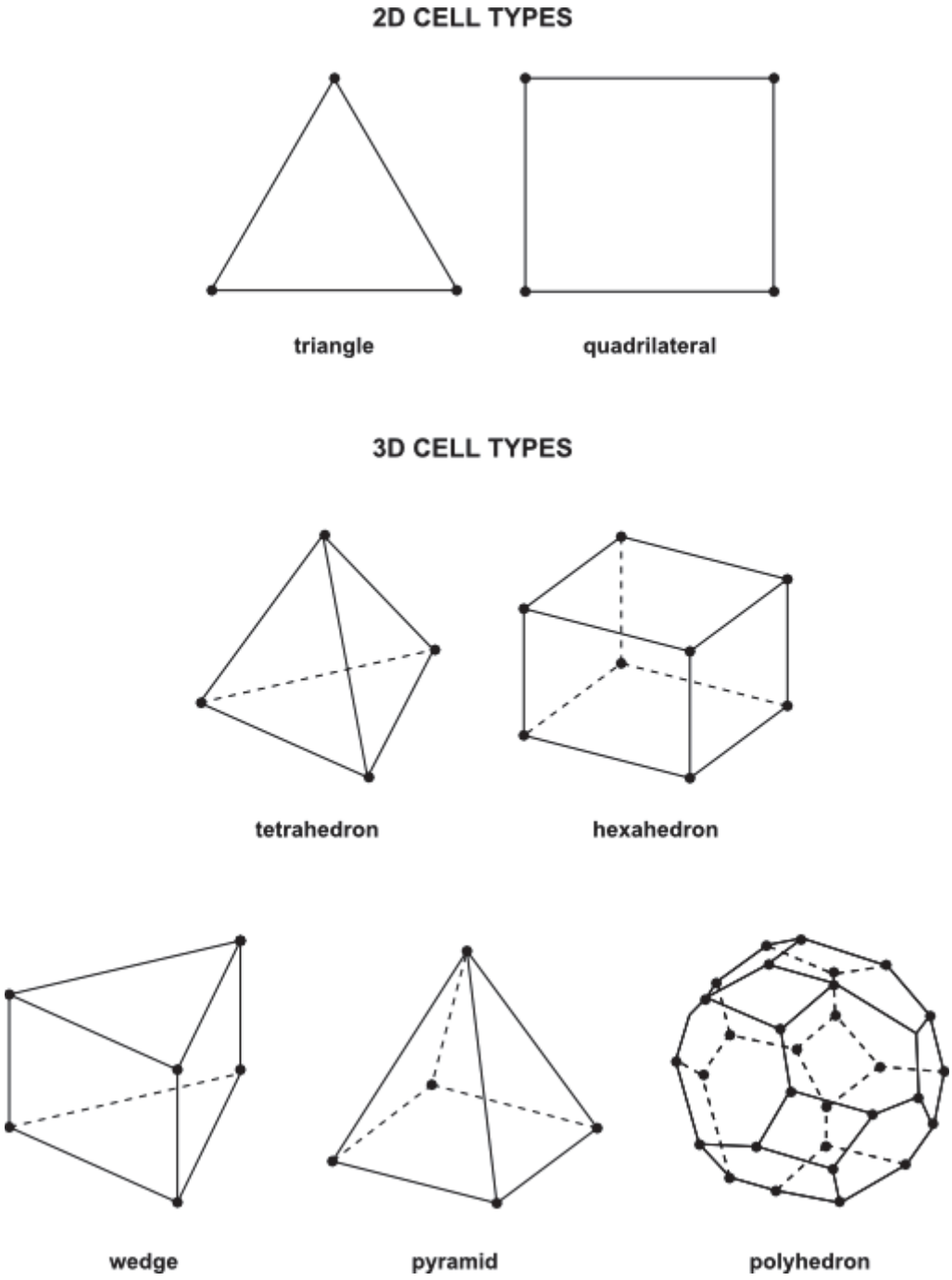
cell types

The various shapes or units that constitute the base elements of a mesh. Ansys Fluent can use meshes composed of tetrahedral, hexahedral, pyramid, wedge, or polyhedral cells (or a combination of these).

Figure 8: Cell Types



computational fluid dynamics (CFD)

The science of predicting fluid flow, heat transfer, mass transfer (as in perspiration or dissolution), phase change (as in freezing or boiling), chemical reaction (for example, combustion), mechanical movement (for example, fan rotation), stress or deformation of re-

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	lated solid structures (such as a mast bending in the wind), and related phenomena by solving the mathematical equations that govern these processes using a numerical algorithm on a computer.
console	The console is part of the Ansys Fluent application window that allows for text command input and the display of information.
convergence	The point at which the solution is no longer changing with each successive iteration. Convergence criteria, along with a reduction in residuals, also help in determining when a solution is complete. Convergence criteria are pre-set conditions on the residuals that indicate that a certain level of convergence has been achieved. If the residuals for all problem variables fall below the convergence criteria but are still in decline, the solution is still changing to a greater or lesser degree. A better indicator occurs when the residuals flatten in a traditional residual plot (of residual value vs. iteration). This point, sometimes referred to as convergence at the level of machine accuracy, takes time to reach, however, and may be beyond your needs. For this reason, alternative tools such as reports of forces, heat balances, or mass balances can be used instead.
cortex	A utility that manages Ansys Fluent's user interface and basic graphical functions.
data files	Files that contain the values of the flow field in each grid element and the convergence history (residuals) for that flow field.
dialog boxes	The separate windows that are used like forms to perform input tasks. Each dialog box is unique and employs various types of input controls that make up the form.
discretization	The act of replacing the differential equations that govern fluid flow with a set of algebraic equations that are solved at distinct points.
GUI	The graphical user interface, which consists of the main Ansys Fluent application window, dialog boxes, graphics windows, etc.
mesh	A collection of points representing the flow field, where the equations of fluid motion (and temperature, if relevant) are calculated.
models	Numerical algorithms that approximate physical phenomenon (for example, turbulence).
node	The distinct points of a mesh (p. 195) at which the equations of fluid motion are solved.
postprocessing	The act of analyzing the numerical results of your CFD simulation using reports, integrals, and graphical analysis tools such as contour plots, animations, etc.
residuals	The small imbalance that is created during the course of the iterative solution algorithm. This imbalance in each cell is a small, non-zero

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	value that, under normal circumstances, decreases as the solution progresses.
skewness	The difference between the shape of the cell and the shape of an equilateral cell of equivalent volume. Highly skewed cells can decrease accuracy and destabilize the solution.
solvers	Ansys Fluent has two distinct solvers, based on numerical precision (single-precision vs. double-precision). Within each of these categories, there are solver formulations: pressure based; density based explicit; and density based implicit.
terminal emulator	See console (p. 195).
TUI	The text user interface, which consists of textual commands that can be entered into the terminal emulator.

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