

Code Release Highlights

Winter 2026

SIERRA 5.28
 CUBIT 17.08
 SPARC 26.2
 SANDIA ANALYSIS WORKBENCH (SAW) 2.14.6

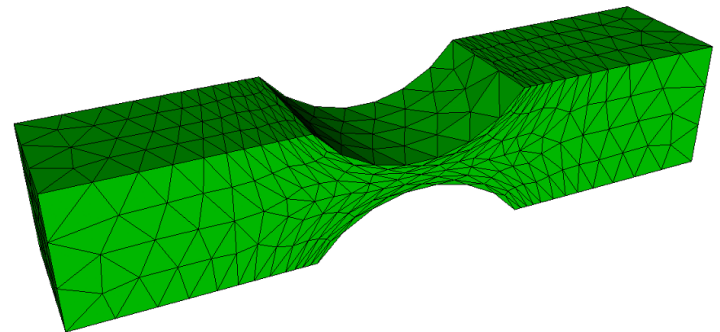
Researching, developing, and deploying state-of-the-art high performance computational engineering simulation codes.

Codes are actively being used for B61, B83, W76, W78, W80, W87, W88, W93, ND Components & Transportation programs. A large fraction of the codes' internal compute cycles supports the Nuclear Weapons Complex: Captive-carry/free-flight aero/acoustic/structural coupled multi-physics for component design, normal/severe mechanical impact scenarios, abnormal thermal structural capabilities, normal/abnormal thermal simulations, aero/aero-structural spin-to-arm, and abnormal mechanical/accidents simulations.

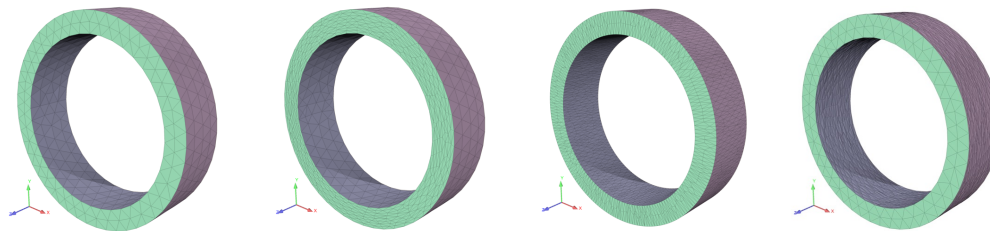
Unstructured Anisotropic Meshing

Sierra 5.28 features advancements in unstructured anisotropic meshing in Cubit® and Emend. Cubit® can now generate anisotropic tetrahedral meshes that follow an input tensor field. This can currently be specified as an axis aligned sizing field on a background mesh, or by specifying an anisotropic sizing factor for elements near a geometric surface, and a growth factor as elements move away from the surface.

The Emend toolkit for mesh adaptivity has also been extended to be able to adapt to fit anisotropic axis aligned or cylindrical sizing fields associated with CAD geometries, allowing for in-situ anisotropic mesh adaptivity that conforms to CAD geometry. These meshes can be used to reduce element count in simulations using unstructured tetrahedral meshes.



An anisotropic tet mesh using two source surfaces with a near size and growth factor.



An input mesh (left) with sizing field and refinements in the r , θ , and z directions, respectively.

Code Team Office Hours:

- Cubit/Percept: Mondays 3:30-4:30 MT on [MS Teams](#)
- Sierra Thermal/Fluid: Tuesdays 10:00-11:00am MT on [MS Teams](#)
- Sierra Toolkit: By appointment at stk-ngpteam@sandia.gov
- Sierra DevOps: Tuesdays 10:00-11:00am MT on [MS Teams](#)
- Sierra Solid Mechanics: Thursdays 10:45-11:30 MT on [MS Teams](#)
- Sierra Structural Dynamics: By appointment to wg-sddev@sandia.gov
- SPARC: Mondays & Thursdays from 9:00 –11:00 MT on [MS Teams](#)
- SAW: By appointment at saw-help@sandia.gov
- Post questions or issues at any time on the [CompSim Community Channels](#)

Deployment is across the DOE Nuclear Weapons Complex, DoD, and AWE: Sierra is deployed on 10 different computing platforms (desktop & HPC), supports 400+ internal SNL users and 70+ distinct external licenses. Cubit is deployed on 3 different architectures (Windows, Mac, Linux), regularly hosts 510 internal users and 1500+ external users. SAW supports 300+ users and archives over 30 terabytes of analysis data

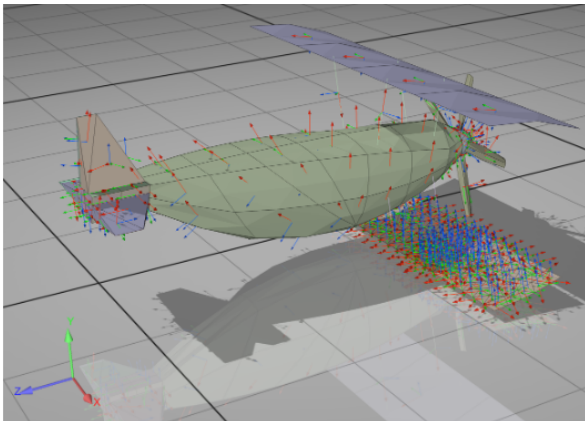
What's New in Sierra

FuSED

- **Capability:** TRACE (TRACE Rapidly Acquires Contour Estimates) has ability to handle continuous label data (instead of distinct class 0/1) with a user-defined threshold.
- **Capability:** OED (Optimal Experimental Design) allows triaxial sensor placement with gradient-based OED
- **Capability:** InverseSD can save heterogeneous design variables to exodus output in the eigen-inverse material, spot weld, and damage identification cases at a user-defined interval
- **Usability:** Gradient-based OED includes baseline sensors in the final printed design.
- **Usability:** The `OPTIMIZATION` block has been reworked for InverseSD. A blank optimization block is now valid syntax and will use ROL defaults. Advanced options now must be set via xml file.
- **Bug Fix:** TRACE users' models are now imported properly from a file. Previously, some users had to explicitly modify their `PYTHONPATH` environment variable, potentially compromising the security of their environment.

Structural Dynamics

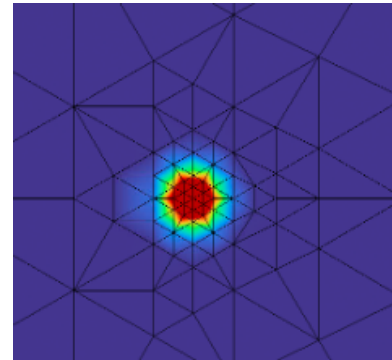
- **Capability:** Coordinate transformations for output are improved. Material direction output is supported for beams and shells (1D and 2D element types) and user outputs have a "transform" capability that allows a user to rotate variables like stress.



New beam/shell material direction output

- **Capability:** Tensor and vector variables may be read in as expression variables for analytic functions.
- **Capability:** Restart is enabled for eigen solutions with residual vectors.
- **Capability:** Element centroid nearest location and at element in HISTORY outputs support any element keyword. Previously, only stress, strain, and von Mises stress were supported.
- **Capability:** Users may output the sum of nodal and element variables as a user-defined global field using the following syntax:
 - `compute global <Name> as sum of [element|nodal] <Variable>`
- **Capability:** Closest distance calculations can utilize block skinning to improve performance relative to full block comparisons.
- **Capability:** The use of multiple loads in `direct-FRF` no longer requires a direct solver; however, use of a direct solver will still give the best performance when not memory constrained.
- **Usability:** The keyword to request the user-defined material direction has been consolidated to simply `material_direction`. The old keywords (`material_direction_1`, `material_direction_2`, `material_direction_3`) have been deprecated.
- **Usability:** The name is optional for the `rigidset` command, and `rigidset` block definitions are a production capability.
- **Usability:** Sierra/SM-style input syntax is supported for the viscoelastic Swanson material model.
- **Usability:** GDSW options to control Tacho solver settings have been updated, improving robustness on ATS-4. Tacho is the default solver on GPU platforms.
- **Usability:** Guardrails have been added to check for missing inputs, such as `frequency` blocks for `modalranvib` solution cases.
- **Usability:** Linear frequency specification for output using `freq_min/freq_max/NF/freq_step` has changed. Previously, the final frequency was the nearest multiple of `F_step` to `F_max` (above or below). Now, the nearest multiple greater than `F_max` is used. Changes to this capability address previous non-intuitive behavior.
- **Bug Fix:** A bug in the superposition solution case was fixed where acceleration/velocity could be zero if pre-requisite output requests were not present.

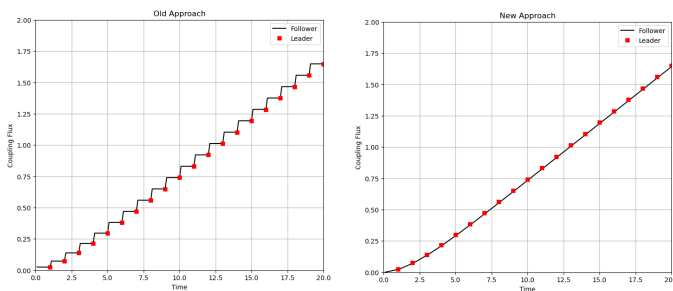
- **Bug Fix:** An error in output of stress and strain at specific locations of Tet10 elements has been addressed, fixing history output at location, line sample output, and some transfer operations.
- **Bug Fix:** Nearest location output for the `modal-ranvib` solution case is fixed.
- **Bug Fix:** The `--check-syntax` capability has improved robustness for frequency domain solution cases.



Example adaptively refined mesh near a local source, which no longer results in smaller time steps than a uniformly refined case

Thermal Fluids

- **Capability:** Added a new time-interpolation mode for SPARC-Aria coupling when SPARC is leading, letting Sierra/Aria interpolate quantities from SPARC as it sub-steps in time.



Change in a transferred quantity from SPARC to Aria during sub-cycling

- **Capability:** The Teko Multiphysics solver now includes a new configuration designed to better handle mesh displacement portions of the solve during coupled ablation simulations. This new configuration resulted in solve time speed ups of 18x on hops, and overall simulation time speedups of 3.6x for a decomposing ablator test case.
- **Capability:** The Teko Multiphysics solver preset now handles automatically splitting bulk nodes into a separate sub-block, significantly reducing memory requirements for solvers when using ILU preconditioning. Complementary changes to the default GMRES restart size also further reduced memory requirements for the Teko solver configuration.
- **Capability:** Added the ability to couple the porous enthalpy equation to bulk nodes – previously this was only possible with the energy equation, but ablation workflows frequently use the porous enthalpy equation on parts of the domain and could not properly interface with bulk nodes.

- **Usability:** The Aria log parser utility has been improved to handle outputs from nonlinear coupling iterations for coupled multi-physics runs.
- **Usability:** Improvements to Sierra/Aria adaptive time step handling no longer penalizes time steps unnecessarily when using adaptive mesh refinement (AMR), improving overall run time for such cases.
- **Bug Fix:** Fixed a bug in Sierra/Aria in the mass-preserving density model preventing the use of density-dependent properties on surfaces and contact interfaces.
- **Bug Fix:** Fixed a bug in Sierra/Fuego affecting the radiative absorption coefficient when mixing EDC and the additional radiation transport model.
- **Bug Fix:** Fixed an issue in Sierra/Aria that prevented applying contact between sub-indexed equation types when using numeric sub-indices.
- **Bug Fix:** Fixed a bug in Sierra/Aria where contact between a multi-phase material and a single-phase material was incorrectly only using the first phase properties when calculating the coupling coefficients.

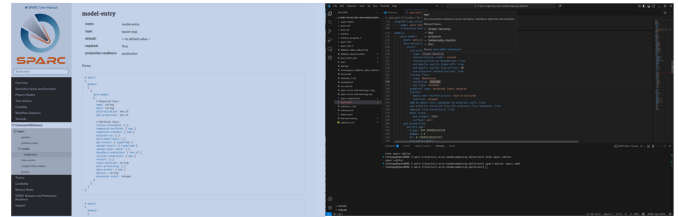
Solid Mechanics

- **Capability:** Improved accuracy of nodal area computation using element shape functions on a patch, e.g., for computing effective traction at nodes
- **Capability:** The `filter` block was extended to support a `butterworth` cutoff frequency option to internally compute appropriate coefficients
- **Capability:** A new option in user output to compute when requested at output can signifi-

cantly improve performance of models with complex or large numbers of derived variable computations.

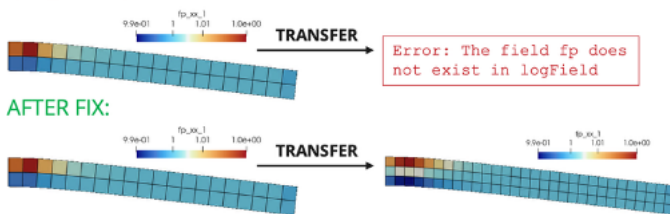
- **Capability:** New option for communication patterns in Zapotec can significantly improve performance and scalability for some models
- **Usability:** L2 transfers now properly treat material state variables (See figure)
- **Usability:** Flex Foam changes enhance robustness and performance by including both flexible and rigid elastic responses in the effective moduli, eliminating the need for an arbitrary scale factor. Users may need to adjust hourglass stiffness to achieve similar resistance activation.
- **Usability:** simplified syntax for creating rigid bodies from multiple mesh entities
- **Deprecation:** contact `search=acme` will be removed in the 5.32 release
- **Deprecation:** The region-level `global energy reporting` command will be removed in the 5.30 release

- A VSCode based editor can be launched from the terminal or used as an extension in a local VSCode installation.
- Enables easy input creation via auto-complete, drop-down selection, and embedded tips.
- **Usability:** The user input command reference is now embedded within the SPARC User Manual for a more seamless user experience.



SPARC user manual (left) now embeds the input command reference for a more seamless user experience. The SPARC editor (right) provides an easy interface to populate input files with embedded tool tips that facilitates problem setup.

BEFORE FIX:



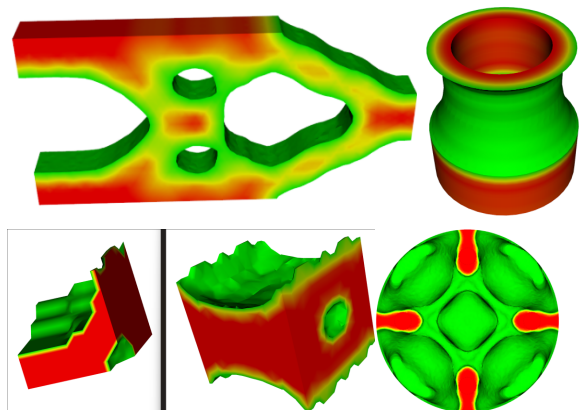
Material state variables are now properly transferred using Lie algebra

PLATO

- **Capability:** Symmetry Filters. Due to non-uniform meshing, topology optimization can generate asymmetric designs even when geometry and boundary conditions are notionally symmetric. Symmetry filters enforce desired symmetric results even in cases of an asymmetric background mesh or asymmetric boundary conditions, often improving convergence behavior of the optimizer and reducing the number of physics solves required.

SPARC

- **Capability:** Improved performance of unstructured discretization (UCCFV): UCCFV is now as fast or in many cases, faster than the structured discretization (SCCFV).
- **Capability:** Enabled reacting gas low fidelity aero models.
- **Capability:** Enabled the use of multiple physics models of the same type.
 - Users can now run Reynolds Averaged Navier Stokes (RANS) simulations coupled to Modified Newtonian Aerodynamics (MNA)/Momentum Energy Integral Technique (MEIT) to provide the turbulence transition indicator.
 - Enables future work in coupled models
- **Usability:** SPARC Editor

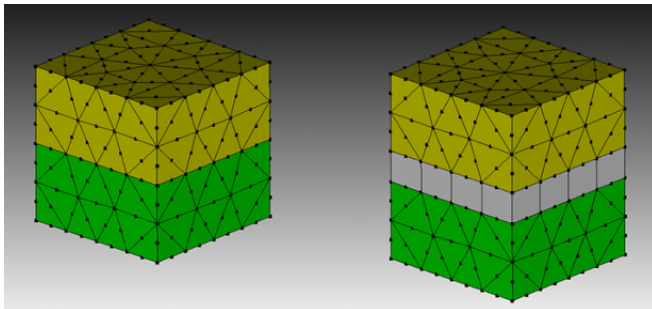


Left to right from top to bottom: sweep, revolve, reflect, and wedge symmetry.

Geometry and Meshing

- **Capability:** Cubit now offers anisotropic tet meshing using a geometry based tensor field or a background sizing mesh. The geometry based tensor field can be specified using a new command:

```
Volume Sizing Function Source Surface Near [theta] Growth_factor
```
- **Capability:** Cohesive Surface Element (CSE) support has been improved to support inserting CSEs in free mesh. Additionally CSEs can now be inserted into TETRA10 meshes, which will result in the creation of WEDGE12 elements. WEDGE12 is a new element type supported by Cubit®



WEDGE12 CSEs inserted in a TETRA10 mesh. CSEs are stretched for illustration purposes.

- **Capability:** Sweeping with redistribute nodes reduces skew from source to target, preserving an uneven node spacing. Improvements have been made to handle more difficult cases.
- **Performance:** Reduction in memory and increase in performance in sculpt refinement
- **Performance:** Opening files containing composite geometry is now more efficient and may be more noticeable on composite surfaces made from a large number of surfaces. Additionally, geometric evaluations on composite surfaces is more robust with a reduction in the number of defects or anomalies in the resulting mesh.
- **Usability:** New visualization of sideset contact pairs helps analysts quickly validate contact intent, catch missing or incorrect pairings early, and reduce time spent debugging contact behavior in downstream analyses.
- **Performance:** When opening Cubit files containing large assemblies, Cubit will now import the file much quicker.

On the Horizon

- (FuSED/InverseSD) Productionization and improved interface identification
- (FuSED/OED) Multi-objective sensor placement optimization
- (FuSED/InverseAria) Support for enclosure radiation
- (FuSED/TRACE) transfer learning
- (SPARC) Embedded error prediction for mesh adaptivity
- (Sierra/SD) Delivery of the Reentry Vibration Toolkit (RVToolkit) as a production capability across Sierra release platforms. Paraview is being evaluated for streamline generation in RVToolkit workflows, to enable analysts to run with the latest versions of SPARC. RVToolkit capabilities are also being expanded, with a new low-Mach Power Spectral Density model added this release cycle.
- (Sierra/SD) Usability enhancements to the Craig-Bampton reduction or superelement capability in Sierra/SD are planned for an upcoming release
- (Sierra/SD) Expanded support for thermal effects across element types
- (Sierra/TF) Further improvements to the SPARC/Aria coupling capability will allow non-synchronized results output when Aria is following with smaller time steps than SPARC
- (Sierra/TF) The ability to automatically define shell elements lining internal enclosures in Sierra/Aria will be available in the next release, which enables using mesh adaptivity on the volume without incurring the cost of an expensive viewfactor recalculation at every step. This also allows separate adaptivity frequency and resolution controls for volumes and enclosures.
- (Sierra/SM) We are targeting production readiness of the Uniform Gradient Hex8 element and select materials on GPU hardware in FY26.
- (Sierra/SM) In-core remeshing with CT10 elements is approaching production readiness.
- (Sierra/SM) A prototype capability for preloading thin/flat structures, such as pads and washers, is in development.
- (Sierra/SM) Prototype the integration of SD solution cases within an SM input deck to considerably improve workflows for common analysis use cases, such as SM preload to SD eigen.
- (SPARC) Automated credibility documentation
- (PLATO) New and improved stress-constrained mass minimization capability.
- (G&M) Morph integration as a meshing scheme in Cubit®
- (G&M) Propagation of Granta material properties