Cradle CFD Version 2021 Release Notes

Overview

We at Software Cradle are proud to announce the release of **Cradle CFD Version 2021** as a multiphysics Computational Fluid Dynamics solution to enhance your productivity and aid smart manufacturing. The packages of scFLOW and scSTREAM are both integrated to **Cradle CFD** on the latest Version 2021.

We are pleased to offer more than 70 new beneficial features and improvements in this version to enhance your CFD analysis and productivity. Below we proudly present a selection of new enhancements, and you can find the complete list in the new features technical documentation on Cradle User Page or MSC SimCompanion.

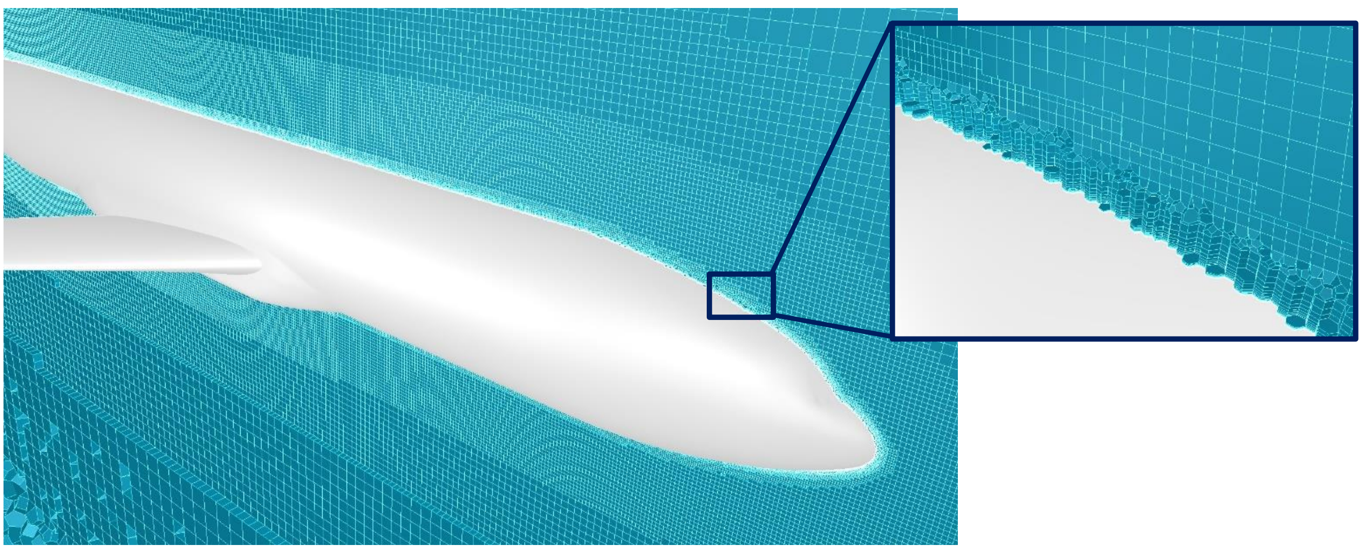
Highlights of New Features

Spatial Hexahedral and Voxel Fitting Meshing Enhancements

Spatial Hexahederal meshes in scFLOW consist of poly- and hexahedral elements that reduce meshing time & the number of element faces, hence; providing runtime speed-up without reduced accuracy. The polyhedral elements in close vicinity of an object's wall excellently reproduce the shape. Then, volume away from the wall, fluid or solid, is filled with hexahedral elements of different sizes. The hexahedral mesh of the mesh sizing octree reduces the number of elements.

Voxel Fitting meshes is a new meshing approach that builds a voxel dominant mesh directly from ether CAD geometry or facetted data, and neither needs to be water-tight. Further, the meshing algorithm inserts prism-layer according to the standard scFlow workflow after the volume mesh generation of all fluids and solids. The result is a drastic reduction in meshing time for the user with little or no accuracy degradation.

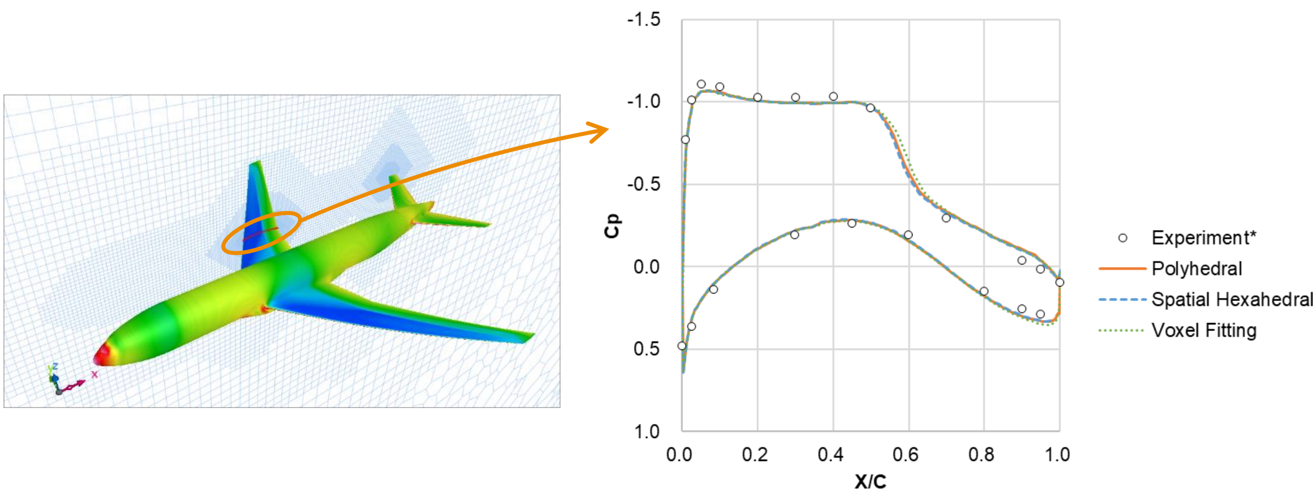
For the realistic NASA Common Research Model (CRM), **40% shorter meshing time** and a **2x calculation speed-up** than a full-polyhedral mesh were observed.



NASA CRM transonic aircraft: Spatial Hexahederal Mesh example.

NASA CRM model meshes size and normalized creation time.

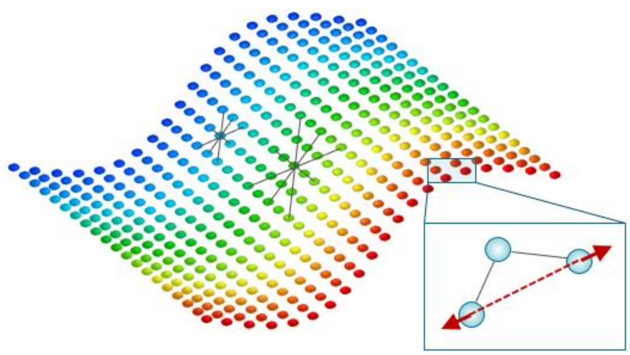
Mesh type	Elements	Ratio of meshing time (16 cores)
Polyhedral	15,571,137	1.00
Spatial Hexahedral	14,041,600	0.56
Voxel Fitting	15,698,435	0.98



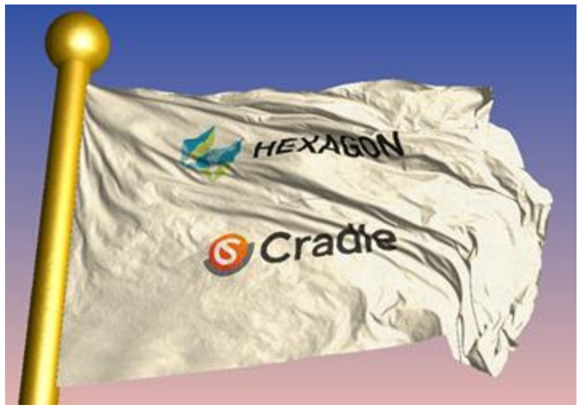
Maintained accuracy for all mesh types

Discrete Element Method Cloth Model

The Cloth model introduction in Cradle CFD software enables simulations to include sheet bodies of textile materials with large deformation utilizing the Discrete Element Method (DEM) algorithm. Forces acting on cloth are calculated as restoring force against stretching, compression, and bending, enabling accurate wrinkling behavior of textile materials. Fluttering of cloth can also be expressed by taking resistance force from the fluid into account.



Cradle CFD Cloth Model



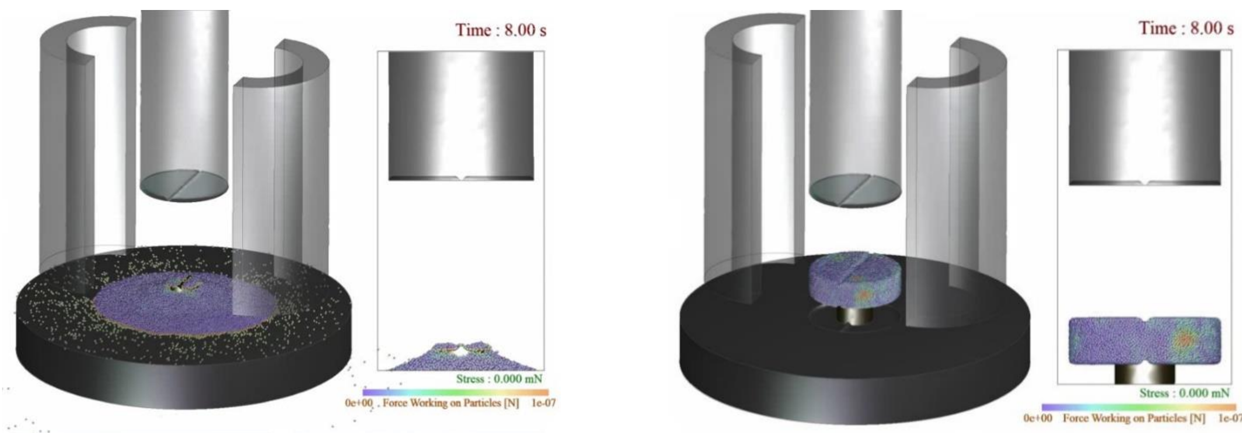
Flag example of fluttering of cloth expressed by taking resistance force from the fluid into account

Discrete Element Method Cohesion / Ad/desorption / Dissolution

New DEM features expand usage in food and chemical processing and pharmaceutical in scFLOW.

- Absorption and desorption of moisture or chemical species by DEM particle
- Dissolution from DEM particles to a solvent such as dissolving a powder medicine in water
- DEM particle cohesion such as wet particles and fine dry powder

These capabilities enable new simulations with and without fluid interaction, such as the pharmaceutical tablet manufacturing process shown below.

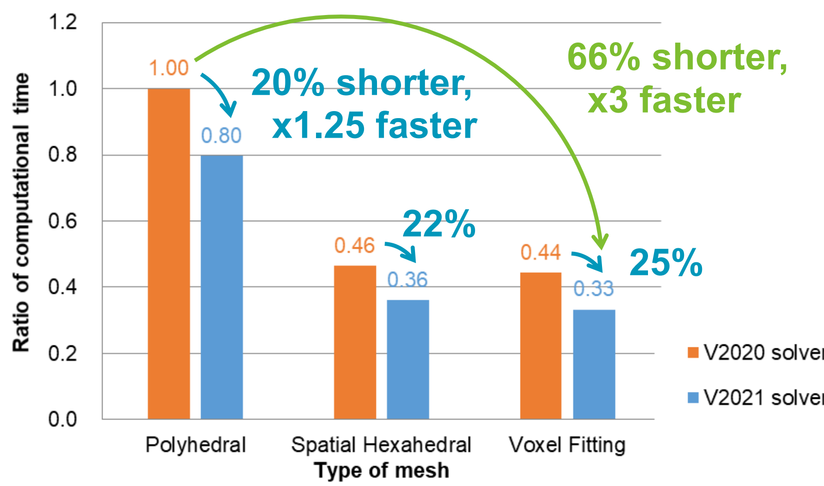


Tablet forming (Left; without Cohesion, Right; with Cohesion)

Enhancement of density-based solver HPC performance

The enhanced density-based solver in scFLOW offers substantial speeded-up without any accuracy loss. Moreover, combined with the new Spatial hexahedral mesh and Voxel fitting mesh, the number of faces is reduced, even with a similar element number that significantly reduces the solver runtimes.

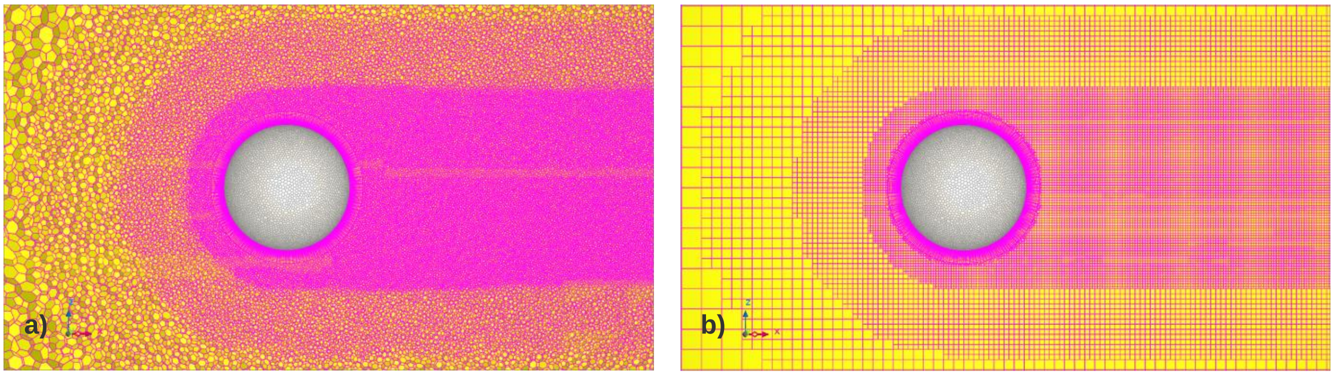
For the NASA CRM transonic aircraft, the density-based solver's enhancements showed a **speed-up of 1.25x**, and when combined with a Voxel fitting mesh with the same Octree, a **total speed-up of 3x.**



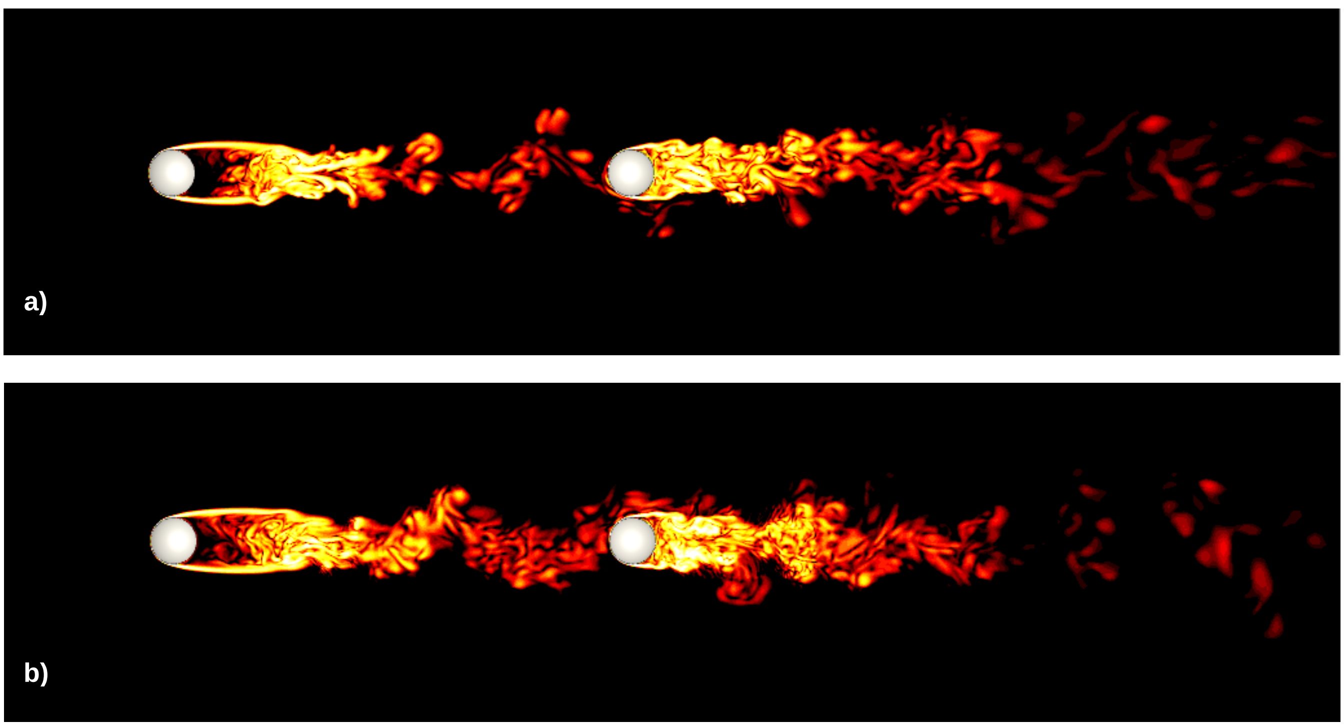
NASA CRM transonic aircraft validation example speed-up for different mesh types using the same Octant configuration for spatial mesh size.

This is in addition to the density-based solver's speed-up of 20~25% for scFLOW v2021 compared to v2020 showcased by the NASA CRM model above.

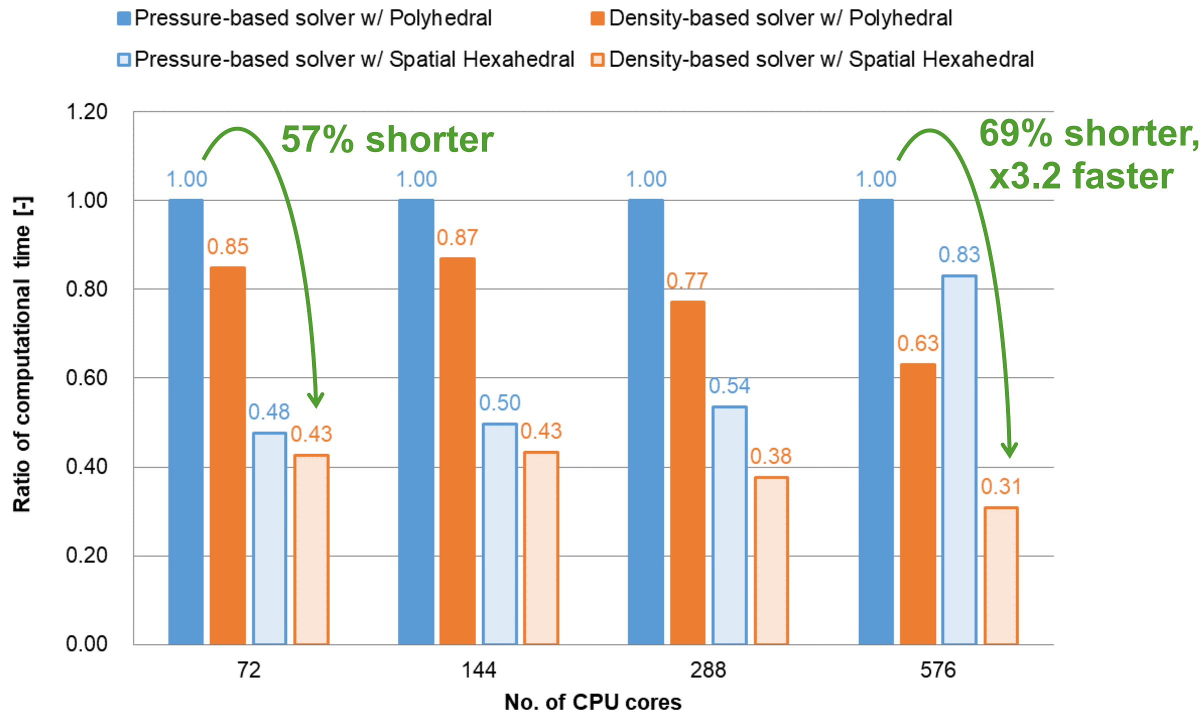
Further, for the classic tandem sphere example, the standard pressure- and density-based solver's HPC performance is easily compared. The density-based solver clearly shows an increasing speed-up as the core count is increased and combined with the Spatial Hexahedral Mesh, keeping the Octree sizing constant the volume mesh, it offers a 3.2x speed-up this case.



a) Polyhedral and b) Spatial Hexahederal mesh discretization
of the forward sphere of tandem sphere example



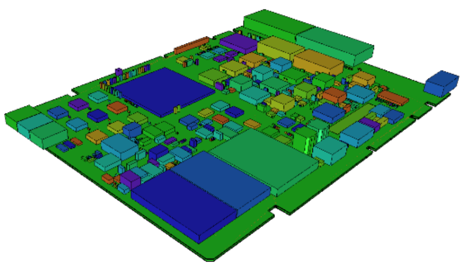
Results visualized for Spatial Hexahederal mesh utilizing the a) Pressure-bases, and b) Density-based solver.



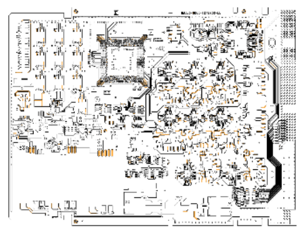
Flow around tandem spheres example speed-up for different mesh types using scFLOW v2021 and the same Octant configuration for spatial mesh size.

IPC-2581 support

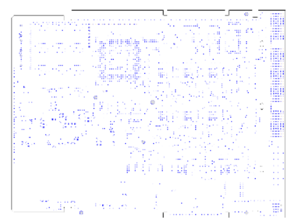
The IPC-2581 file format support in scSTREAM enables importing PCB detailed design data from a single file. IPC-2581 is an open and global file format that extends well beyond CAE, which allows a standardized data transfer between CAE, Manufacturing, Design, etc. The file format stores all relevant information in a single file for accurate, detailed thermal analysis of a PCB, such as Board shape, components, wiring, and thermal via.



Components geometry



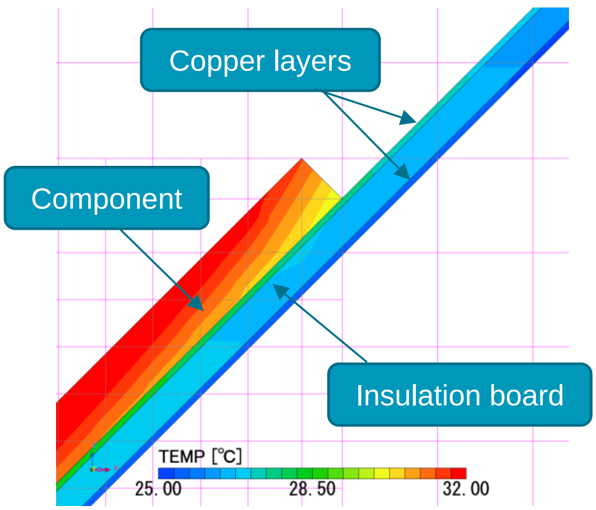
Wiring pattern



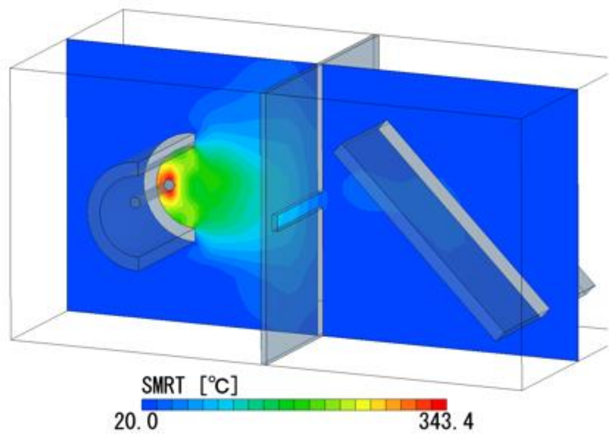
Thermal Via

Improvement of Cut Cell

The Cut Cell capabilities in scSTREAM received enhancements in the v2021 release to support multi-face elements, multiblock and thermal radiation. Furthermore, Cut Cell with multiple elements in a single element enables decreasing the number of elements to reproduce the layered thin parts or casing, which reduces computational cost drastically. Moreover, Using Multiblock also contributes to decreasing computational cost. Supporting thermal radiation promotes the utilization in the field of thermal design.



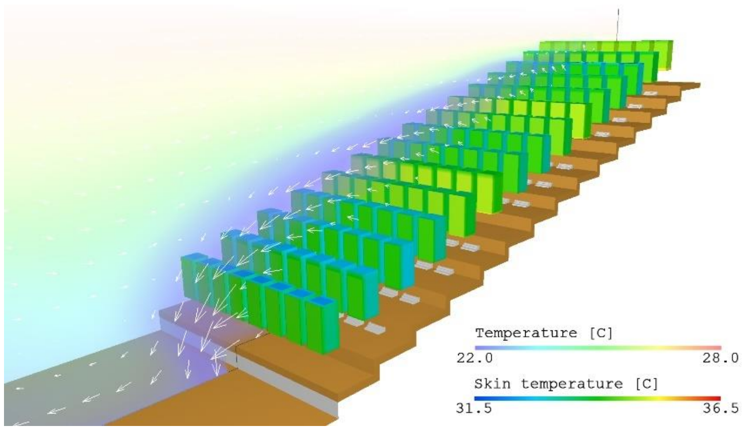
Diagonal laminated PCB with Cut Cell



Cut Cell model with thermal radiation

Thermoregulation model JOS

Software Cradle's unique thermoregulation model (Joint System Thermoregulation Model; JOS), which is now available in scSTREAM, provides detailed information vital for a human's thermal comfort perception (such as skin temperature, skin wettedness by perspiration, thermal sensation, and so forth) in an environment such as a vehicle, a room of a building, etc. The heat and moisture released from human bodies are also evaluated. All of these values are used to calculate temperature and humidity more accurately in the thermo-fluid analysis.



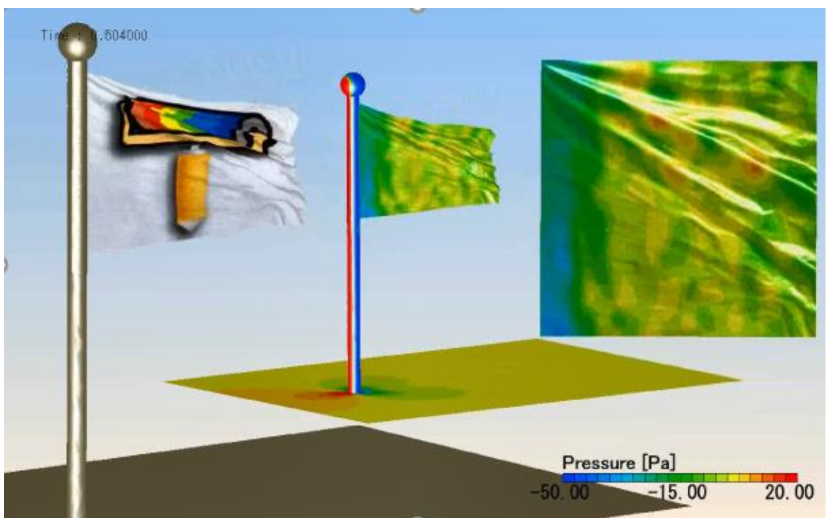
JOS model in an auditorium thermo-fluid analysis

Cloth model display function for textiles

Together with the introduction of the DEM Cloth Model, scPOST introduces the visualization of such a model that includes the following.

Supported visualization techniques in scPOST:

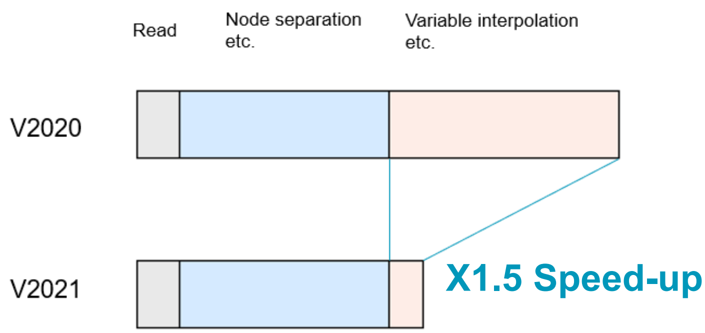
- Texture mapping using imaged files
- Mapping variables (Pressure, etc.) over the cloth
- Water expression and gloss processing as general settings, which enables wrinkling visualization
- Displaying development view of each area



Visualization of flutter analysis of cloth with texture and pressure result mapped.

FPH loading speed-up

By internal software optimization in scPOST result files, fph-files, read receive a 1.5x speed-up. The speed-up was achieved by parallel processing on a per-node instead of a per-element basis.



Breakdown of time to open FPH file

Automotive example of x1.5 speed-up with approximately 7.5 millions elements