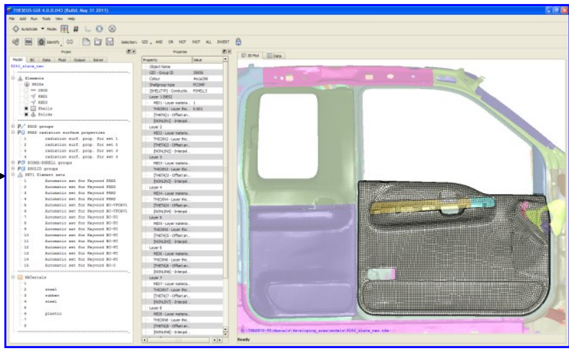
June 2011: Current Software Release - version 4.0

presenting an improved GUI for Windows & Linux

pre-processing in the new GUI:



Starting with...

.nas-file (ascii)

Nastran finite element mesh

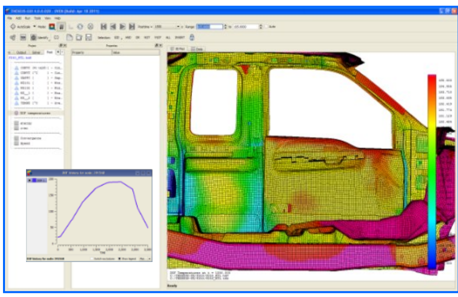
read & write

thermal model (keywords)

.tfe-file (ascii)

THESEUS-FE Solver

post-processing in the new GUI:



results

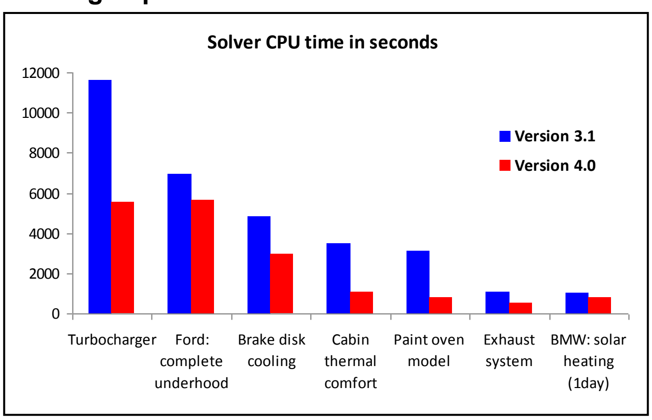
.hdf-file (binary)

read

▪ Highlights of the new GUI

- High speed model handling in the 3D Plot.
- Huge models >1Mio elements supported.
- Now reads tfe-files containing keywords.
- Efficient model creation with element sets.
- Model merge capability.
- Upgraded manikin models.
- Windows & Linux platforms (32/64bit)
- Manipulate geometry: translate, rotate, scale.
- New manuals & tutorials.
- Material keywords (MAT4, MAT5) from Nastran supported.
- Old tfe-files will be automatically converted by the GUI.

▪ New high speed heat conduction solver



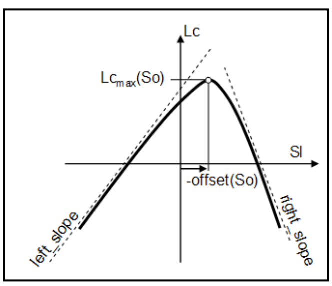
A new matrix preconditioning technique massively reduces linear iterations to solve for temperatures ***T***.

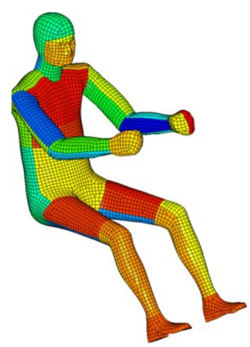
$$K \cdot T = F$$

▪ Zhang's local thermal comfort prediction

Automatic body part assignment applies model parameters on sectors of the manikin FIALA-FE. THESEUS-FE will write Zhang's local thermal sensation index *Sl* and the local comfort index *Lc* on each sector. These indices can be visualized as field results or reviewed in tabular form. Global indices like the overall sensation index *So* and the overall comfort index *Co* are also available.

$$Co = \frac{1}{3}\left[min_1(Lc_{bp}) + min_2(Lc_{bp}) + max(Lc_{bp})\right]$$





Lc : field results from tutorial 8

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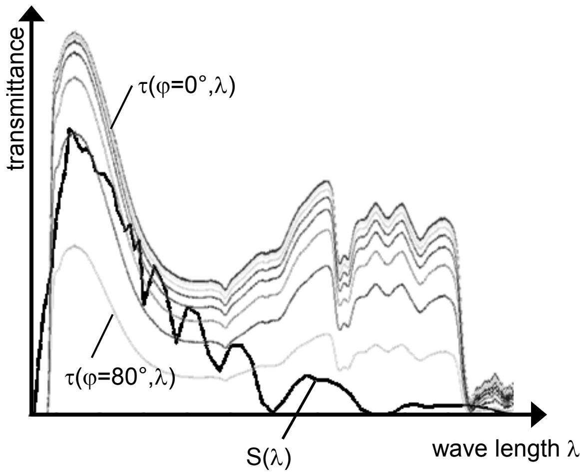
Frequency dependent surface radiation properties

For real materials (e.g. glasses) the radiation properties strongly depend on the wavelength λ of the electromagnetic energy hitting the surfaces. To take this phenomenon into account THESEUS-FE supports a method described in the DIN EN 410.

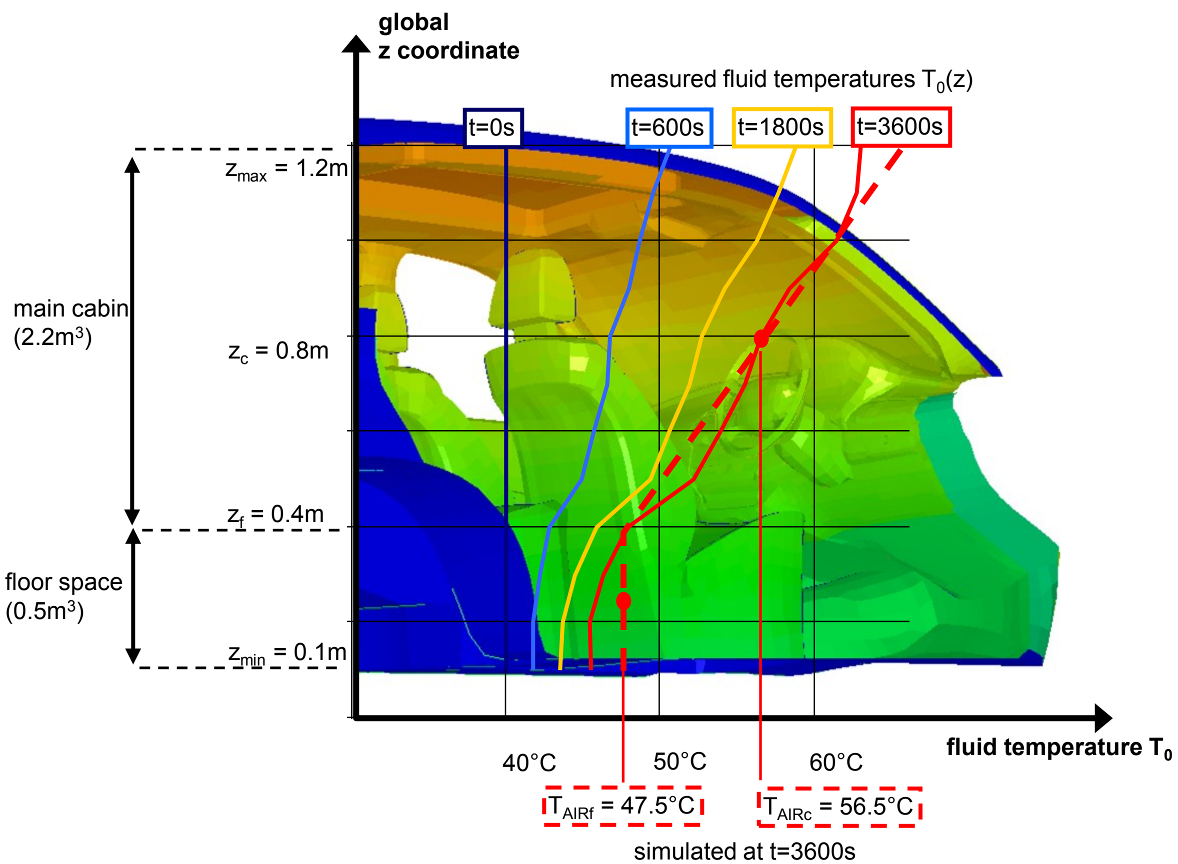
$$\tau(\varphi) = \sum_{\lambda=300nm}^{2500nm} S(\lambda)\tau(\varphi,\lambda)\Delta\lambda$$

The transmittance τ can be a function of the angle of incidence φ and the wave length λ. S(λ) are relative spectral intensities of the global solar irradiation. The new keyword TABMAPF allows the definition of such a wave length and angle dependent function τ(φ,λ) for the transmittance.



Piecewise linear fluid temperature distribution for cabin models

The air temperature in a solar heated cabin typically rises from the bottom (floor) to the top (roof). This phenomenon results from the temperature dependent air density: hot air moves to the top of the cabin and cooler air remains at the bottom (floor space). It is well known from measurements that the air temperature distribution in a solar heated cabin (without ventilation) can be approximated with a piecewise linear function in vertical direction (z axis) as shown in the figures beneath. With the new keyword AIRZCPL cabin models in THESEUS-FE support such temperature distributions for AIRZONEs as shown here:



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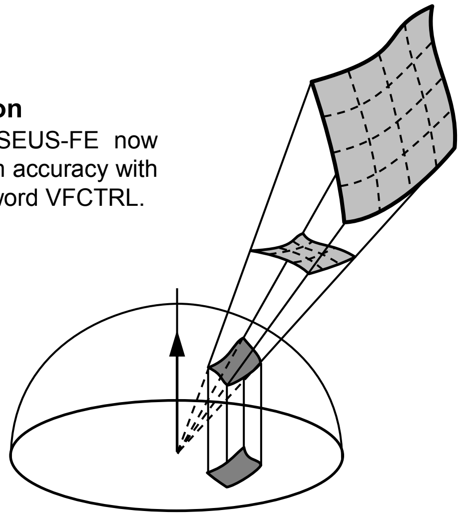
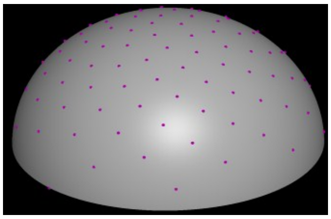
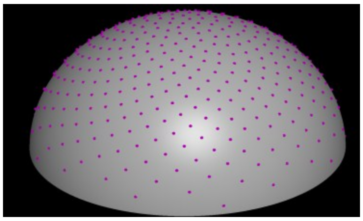
Optimized hemisphere method for high speed view factor calculation

In addition to the existing *surface-2-surface* and *hemicube* methods THESEUS-FE now provides a *hemisphere* method with optimized ray distribution yielding maximum accuracy with a minimum of ray tracing operations. You can activate this method with the keyword VFCTRL.





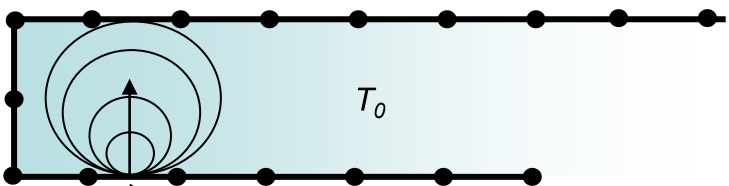
coarse hemisphere:
100 ray intersections



finer hemisphere:
400 ray intersections

Automatic determination of fluid temperatures for small enclosed volumes

In prior versions, small enclosed volumes in automobiles such as A/B/C-pillars, roof cavity, or doors were modelled as VOLUMEs or AIRZONEs. This was a potentially painstaking and time-consuming approach to building the model. THESEUS-FE now offers an automatic approach to deal with convection in small cavities. For small (nearly) enclosed volumes the fluid temperature T_0 at an element side can be approximated using the temperature values of nearby element surfaces. This is based on the observation that an enclosed fluid volume will adopt the area-weighted average value of all enclosing element facets. This feature can be used in convective boundary conditions like BC-C or BC-FC by specifying the special argument AUTO as ambient fluid temperature.



$$\dot{Q}_{convec.} = A \cdot h \cdot (T - T_0)$$

Multilayered carbon fibre reinforced plastic (CFRP)

The new composite keyword PCOMP together with orthotropic conductive material definitions (MAT5) permits the modelling of multilayered carbon fibre reinforced plastics. Fibre directions can be rotated with a user-defined offset angle per layer and for each shell element.

New and faster thermal contact algorithms

The new general contact CONTACTG offers an easy way to define conductive contact regions without explicit master/slave definitions. The contact search algorithms has been accelerated, using ray tracing techniques from the view factor calculation.

New features in the THESEUS-FE Transformer

tfe converter, MATerials converter, extract from hdf, map results from/to STAR CCM+ exchange files...

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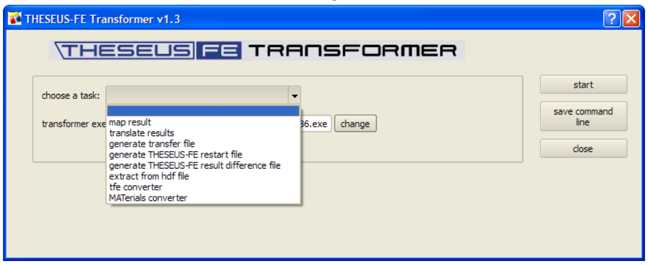

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