3D-Visualization and Communication Solutions for CAE Workflows

Armin Sager

Ceetron GmbH, Fellbach, Germany

Summary

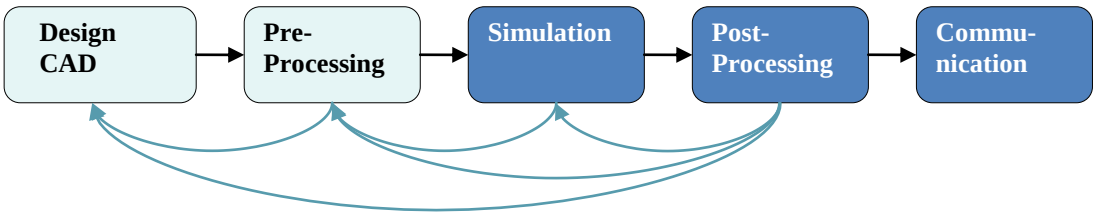
Advanced 3D-visualization technology provides powerful post-processing of results from any of the most common structural mechanics and fluid dynamics solvers. This is available in several commercially available post-processors today. Extending post-processing by empowering the user to communicate the essence of his analysis utilizing free viewing components stands out from the crowd. Learn from examples how such components can serve as the visualization backbone of a CAE workflow that maximizes the effectiveness of your CAE-team and improves your communication to external parties.

Keywords

3D-Visualization, Post-processor, CAE workflow component

1. Challenges in the CAE Workflow

The classical CAE workflow goes through interdependent stages with various needs for loopbacks, depending on the nature of the product being analyzed, the experience of the team and the complexity of the analysis being performed. This can be depicted as in the following figure. Note that communication with coworkers outside of the core CAE team provides additional feedback for all previous stages.



The stages in the workflow have been the same for years, but the rapid evolution of computer hardware and software have enabled faster throughput, more accurate results and more wide-spread use. This has also enabled the engineers to create and work on larger models than ever before, and to undertake even more complex tasks like coupled analysis and multi physics analysis.

Put together, this development places increasing demands on:

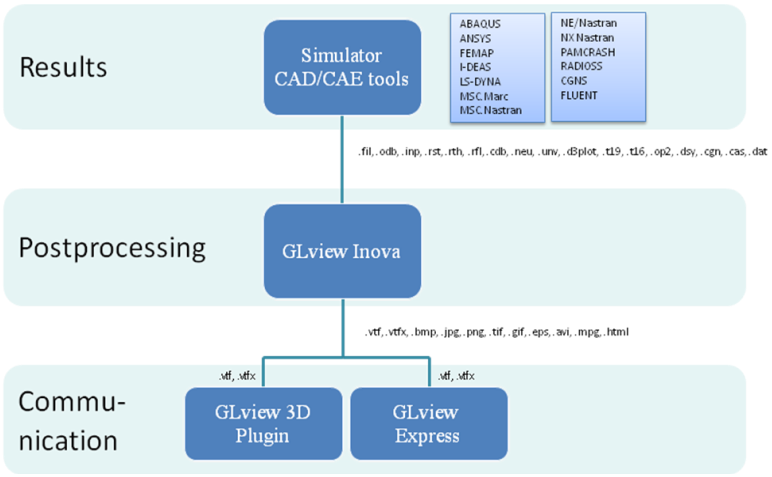
- Data storage space
- Redundancy and version control
- Access and security
- Data transfer and communication paths

2. 3D-Visualization is essential

"If a picture says more than 1000 words – an interactive 3D animation says it all …"

For each stage in the workflow the team can benefit from having a common tool that will allow them to quickly inspect the status of the design visually to be able to determine the next step. A free, lightweight engineering tool with fully interactive 3D animation and the ability to carry the actual result data will improve the communication in the CAE team and enable them to reach better conclusions faster.

This article focuses on examples from the stages in the CAE workflow following a simulation – the post-processing, presentation and communication of the final results. It will show you 3D visualization tools that improve the communication between all parties in the whole workflow, and at the same time help to reduce the impact of the challenges stemming from the increased data loads.



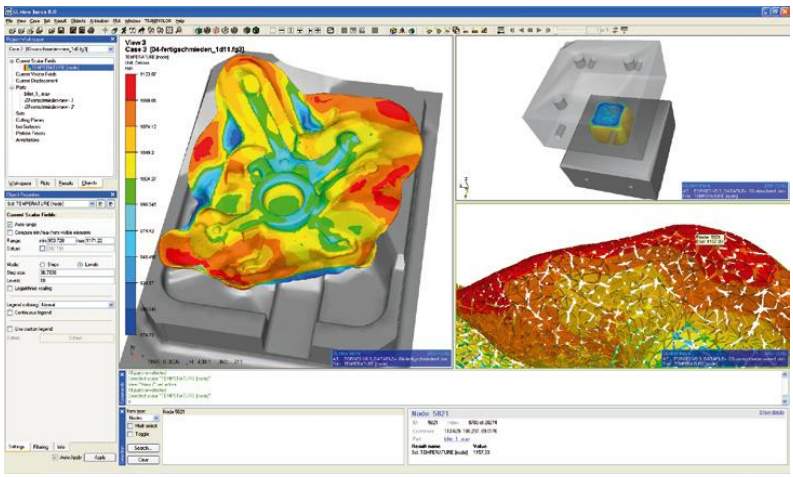
3. Example

The following example from the automotive industry is used to illustrate how lightweight 3D visualization tools in combination with a compact and flexible file format can be used in the CAE workflow to improve the communication in the team. The example uses models from a hot metal forging process to create a steel knuckle for the chassis of the Maybach car starting with a solid block of steel as initial part:

Initial part Final part

The producer, CDP Bharat Forge, used the forging software Forge by Transvalor to optimize each stage of this multi-stage forming sequence.

As the complete process is planned and analyzed, lightweight files can easily be produced for each stage to enable the team to visualize the models and important results in full 3D with full interactivity. By giving the whole team access to the same information, correct decisions may be reached faster, and the reasoning for the conclusions will be understood by all members of the team.



The preparation of meetings is more effective, because a single slide with an animated 3D-Model communicates more information than several slides with stills or animations with fixed perspective.

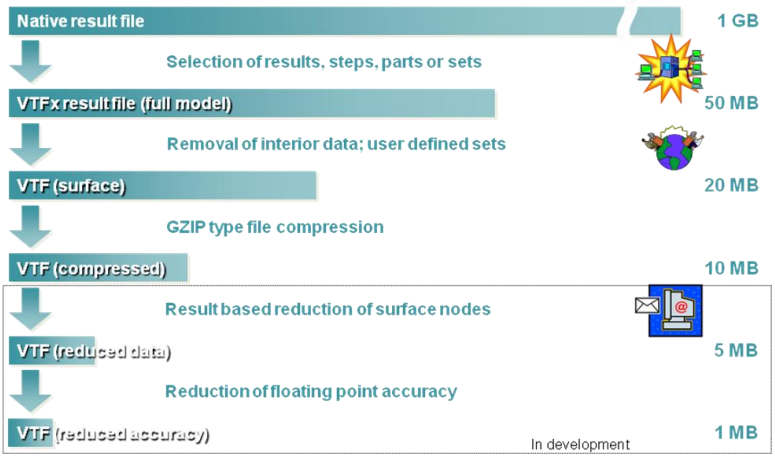
4. File size reduction techniques

As already mentioned, demands for data storage space is rapidly increasing. At the same time, more and more companies operate on a global scale and need to collaborate remotely with various departments or even with alternating external partners. Both these factors make it interesting to deploy techniques suitable to reduce the size of the files exchanged and stored while retaining the technical information that is required to draw the right conclusions – the team must be able to communicate the essence of the analysis with ease.

For the metal forming example above file sizes are reduced from 2.7 GB in the original format to 67.4 MB by:

- Selection of individual results, steps, parts and sets to include
- Removal of interior data
- Export of 1st order nodes only
- GZIP type file compression

This particular real world analysis example shows that substantial file size reductions can be achieved even if several complex models with adaptable meshes are involved. The resulting files are small enough to be easily distributed – different to the original files. In other common scenarios even better file size reductions are typical as illustrated in the figure on the right.



Such size reduction offers an additional advantage. It allows to routinely archive interactive 3D-models for documentation purposes which can be reviewed within minutes without the need to rerun the simulation itself.

5. Security and Integrity

Now that transfer of analysis results between locations and organizations over the Internet is a viable option, the ability to protect the content of the file becomes more important. Two mechanisms are available to ensure that the data reaches the recipient in its original form and that only the intended recipient(s) can read it:

- Password protection prohibits unauthorized use with the viewing components and the application that created the data.
- Data encryption further strengthens the security by making the contents unreadable by other tools thereby preventing any type of tampering.

6. Remote visualization

As indicated earlier, more and larger simulations are being used to explore designs and processes. Simulation calculations often get executed on servers or computer clusters and their results are stored on file servers. To avoid having to duplicate and/or to transfer these files to local workstations for post-processing, the files should be accessed where they are generated and stored.

A remote visualization server utilizing the same set of techniques already discussed for file size reduction can facilitate such a scenario while substantially reducing the total load on the network. The client only loads the data necessary to reach a conclusion – and the engineer is able to easily produce a lightweight file containing enough information to communicate his or her findings to coworkers, managers, partners and clients.

7. Conclusion

3D-Visualization technology gains in importance in CAE workflows because this is the only feasible way for the calculation engineer to interpret the results of huge simulation data sets and to compare multiple cases efficiently. The CAE workflow also needs to include coworkers, managers, partners and clients who might not have an in-depth CAE engineering background or necessary tools available. The engineer in his role as “content producer” has the tools and file formats available to provide 3D-visualisations to these “content consumers” to make communication and collaboration more effective and pleasant for all participants.