AFDEX Newsletter
Q2 / 2023

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Contents

1. AFDEX_V23R01 Release

New version AFDEX_V23R01 will release on this April. The release schedule was delayed by a month due to improving the completeness of new features and fixing bugs. Of course, emergency improvements have been supported from time to time through the improved AFDEX_V21R03 version. Moreover, the beta features of AFDEX_V23R01 have been available in V21R03. The improvement plans for solver and pre/post-processor have been introduced in the AFDEX newsletter 2022 Q3, Q4 and 2023 Q1.

The main new features in AFDEX_V23R01 are as follows:

< AFDEX Newsletter Q3/2022 >
- Object remeshing feature in multibody analysis
- Improved UI for node and element information in multibody analysis case
- Result file compression
- UI for inputting translation distance of dies in multi-stage process analysis
- UI for inputting number of element for remeshing in die structural analysis

< AFDEX Newsletter Q4/2022 >
- Pre-processor improvement for shape rolling process analysis
- Pre-processor improvement for crack analysis
- Scale tool for material after forming

< AFDEX Newsletter Q1/2023 >
- Temperature compensation for cylinder compression testing
- Direct method for calculation peak strain
- Automatic simulation of Pilger rolling
- Local material-motion constraining function and its application
- Boss forming simulation
- Simulation of tube drawing process with non-uniform thickness and die misalignment
- Quenching & Tempering simulation of Jominy testing
- Automatic mesh density control for 3D dies
- Temperature input for shrink fit in multi-body analysis
- Friction condition in multi-body analysis

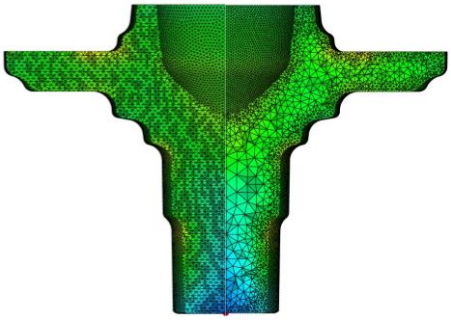
2. New Features in AFDEX_V23R01

Most of new features in AFDEX_V23R01 are already available as beta features in AFDEX_V23R01, which were introduced through the AFDEX newsletter for the past year. Now, we would like to introduce the recently added features of AFDEX_V23R01 beta version.

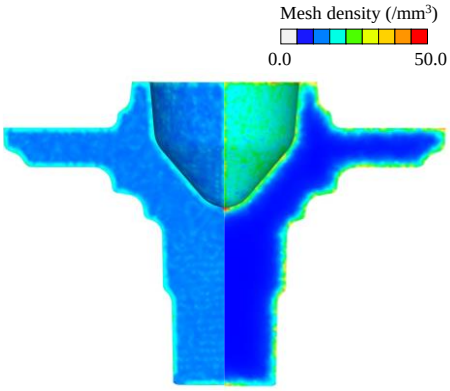
2.1 Effect of Mesh Density Visualization Feature and Density Distribution on Analysis Results

In AFDEX_V23R01, 3D internal element visualizing feature (Figure 2.1) and element density distribution visualization feature (Figure 2.2) are officially provided.

Figure 2.1 shows that the two meshes do not generate large errors in terms of the deformation shape of the material. Therefore, non-uniform meshes (coarsen mesh) has been recommended for the case of simulation focusing on forging possibility in terms of computational efficiency. From an empirical point of view, however, a severe non-uniform mesh may have a negative effect on the accuracy of a result if the target is stress distribution of dies with a large local deformation. For a detailed information on this, please refer to our academic references.



(a) Uniform meshes (b) Non-uniform meshes
Figure 2.1 Visualization of internal mesh



(a) Uniform meshes (b) Non-uniform meshes
Figure 2.2 Distribution of mesh density

2.2 Support for Multilingual Characters

AFDEX_V23R01 supports multilingual data and data-saving system for names of analysis input and result files, and words, phrases, and sentences in the analysis input file. Therefore, miscellaneous files are read and saved in UTF-8 format.

Also, the new version of AFDEX supports all the multilingual characters for all types of file paths, file name, and DB files.

Figure 2.3 shows the multilingual character support on AFDEX_V23R01 using Japanese.

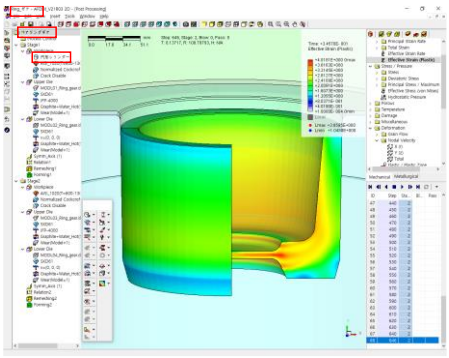


Figure 2.3 Support for multilingual characters

2.3 Analysis of Cone-type Rotary Piercing Process

A simulation of barrel-type rotary piercing process has been supported by older versions of AFDEX (M. S. Joun et al., 2014, Quantitative study on Mannesmann effect in roll piercing of hollow shaft, Procedia Engineering, Vol.81, pp.197-202). AFDEX_V23R01 provides not only the simulation of barrel-type rotary piercing process, but also that of cone-type rotary piercing process used for manufacturing seamless pipes.

Figure 2.4 shows a typical analysis results of cone-type rotary piercing process.

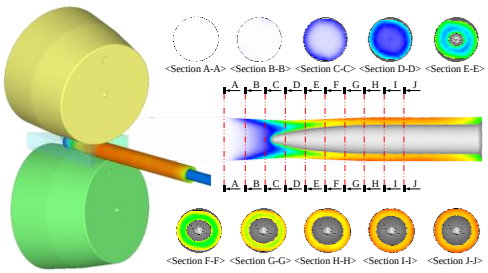


Figure 2.4 Analysis result of cone-type rotary piercing process

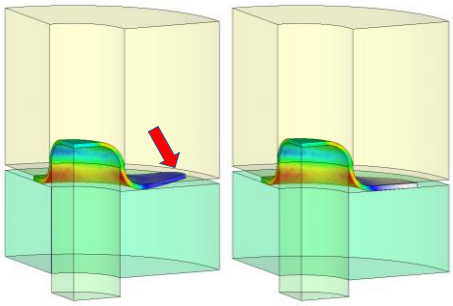
3. AFDEX_V23R01 Improvements

3.1 Binder Feature in Plate Forging Analysis

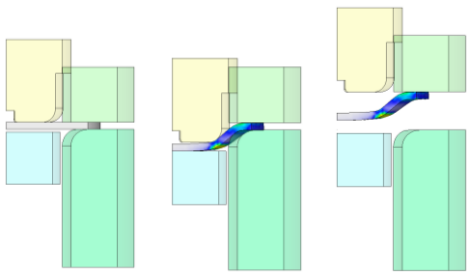
The binder feature, which requires for unloading, has been greatly enhanced from AFDEX_ V21R03 to AFDEX_V23R01 beta version. However, when a workpiece undergoes severe plastic deformation, malfunction of a binder or penetration of a material into the binder have been found and improvements in these problems are currently being made.

Figure 3.1 shows an error that occurs when the maximum compression distance of the binder is reached, and a remedy for abnormal penetration of the material into the die. Before the improvement, the material penetrated while the contact condition between the material and the binder is satisfied after the improvement.

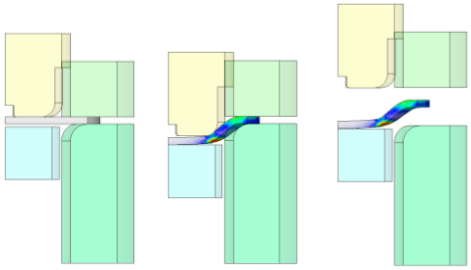
Figure 3.2 is an example of the other error that the material rises while sticking on an upper die, which the nodal separation condition is improved.



(a) Before improvement (b) After improvement
Figure 3.1 Improved binder feature



(a) Before improvement



(b) After improvement
Figure 3.2 Improvement of binder feature for unloading

3.2 Reduced Loading Time for Opening STL File

In the case of a large STL files or a large input file during Stage-by-stage continuous analysis, the loading of the pre-processor takes long. In the new version, the loading time of the large STL file had been dramatically reduced. For example, the loading time of about 1GB STL file shown in Figure 3.3 was reduced from 110sec to 30sec.

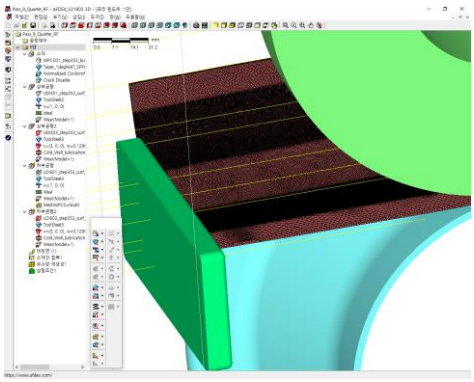


Figure 3.3 Loading large STL file

3.3 View Feature of Load-Displacement Curve

Previously, a displacement of die in load-displacement curve has been defined as the sum of maximum relative distance of die obtained in each step. It has been highly difficult for users to estimate the displacement when running the simulation using a binder with unknown velocity.

In the new version, the maximum value among the distances of each die moved except binders will used as a displacement in the Load-Displacement

Figure 3.4 is an example using a die with a spring attached to Upper Die-2. In older versions, time and displacement (the absolute value of maximum velocity is 1mm/s) did not match due to the relative displacement of binder. In the new version, the values of time and displacement are the same as shown in Figure 3.4.

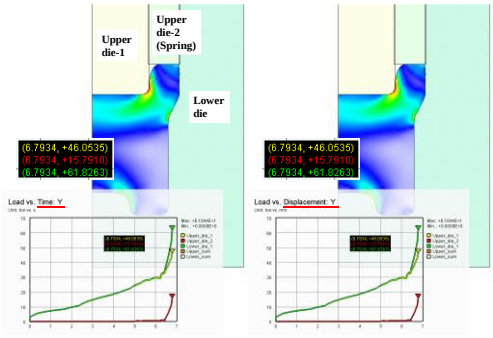


Figure 3.4 Load-Time & Load-Displacement curve

4. Notice

4.1 Online Training in 2023

In response to the continued evolution of the COVID19 pandemic, all the training programs stand cancelled and MFRC is shifting in-person training to online training for applicants only. Also, the tutorials and theories are uploaded on MFRC's YouTube channel. The following subjects will be provided: mathematical background, tensile testing, statics, solid mechanics, introduction to plasticity theory, finite strain, finite element method, and all materials related to metal forming, etc. Although the online lectures originally aim to help college students understand the materials, it can also be utilized as the materials introducing theories and mechanics used in AFDEX. For more details, please refer to the link below. (https://www.youtube.com/c/AFDEX)