AFDEX Newsletter
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MFRC
www.afdex.com, mfrc@afdex.com
Tel: +82-55-755-7529, Fax: +82-55-761-7529

Contents

1. AFDEX_V23R02 Release

At the end of November 2023, AFDEX_V23R02 was released with new features and enhancements. The next version of AFDEX, V24R01 version, will be released in this June 2024.

Sections 2 and 3 introduce the main contents and application cases related to the new and improved functions of AFDEX V24R01 version.

2. AFDEX_V24R01 Improvements

2.1 Pre-processor for Roll Forging Process Simulation

Up to version V23R02, there was inconvenience in using the roll forging process simulation, which one has to apply basic conditions and boundary conditions of rolls and workpieces on the AFDEX pre-processor and *.txt file separately. As shown in Figure 2.1, in AFDEX V24R01, all input data can be entered together in the pre-processor to offer greater convenience.

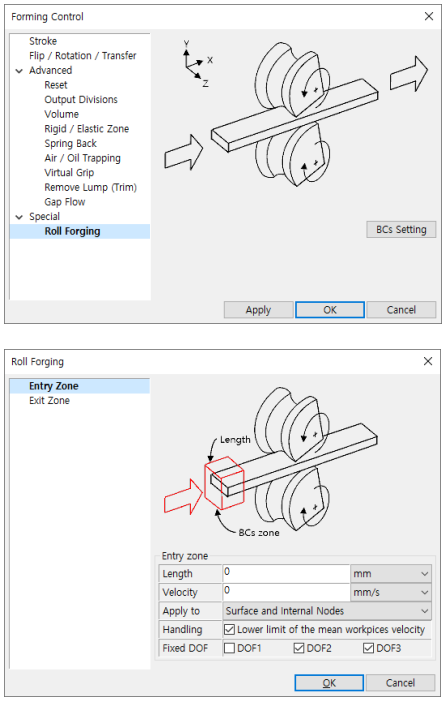


Figure 2.1 Setting dialog box for roll forging

2.2 Visualization of Contact Region between Models during Multi-body Analysis

Previously, in the multi-body analysis results, a contact region between CAD models could not be easily detected. AFDEX V24R01 provides the enhanced feature that display the contact region between all models, including die-workpiece as well as workpiece-workpiece. Figure 2.2 shows an example of applying the new function to the example in which three models are deformed by two dies and a binder. Users can visually check if there is any contact between different models with different colors. The two colors at the bottom (yellow, pink) represent the contact state between the three deforming bodies.

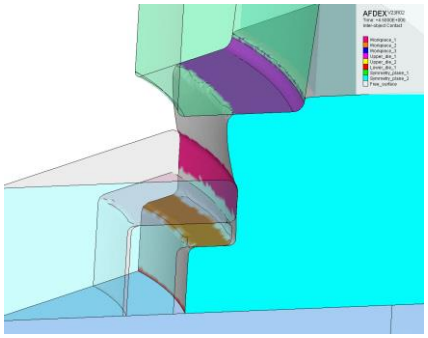


Figure 2.2 Contact area between objects

3. AFDEX_V24R01 Improvements

3.1 Feature Enhancement: Workpiece Transformation (Rotation and Translation)

Previously, two types (Vector, Table) of workpiece rotation and translation features had been supported. For 'Table' type, cases where the central axis of a workpiece was slightly misaligned occurred intermittently, when combining translation and rotation of the workpiece. To resolve this error, the 'Table' type function is improved. Also, the 'Vector' type which has been already supported can be implemented as a 'Table' type. (See Figure 3.1) In addition, the features for rotating/translating workpieces based on absolute coordinates will be provided in AFDEX V24R01.

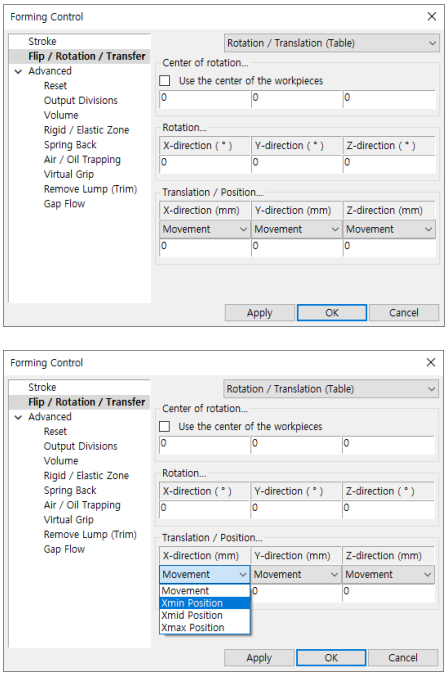


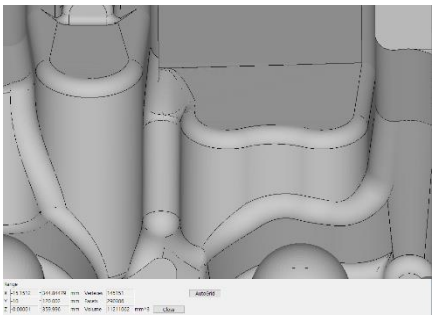
Figure 3.1 Workpiece rotation and translation

3.2 Feature Enhancement: Error Detection for 3D STL File

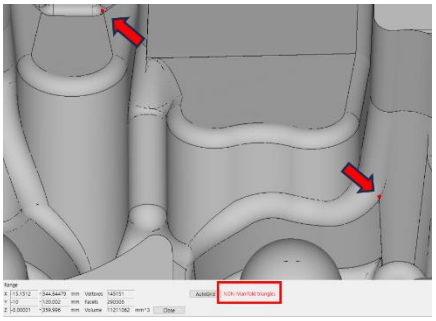
STL file format is widely used for 3D models of dies and workpieces in AFDEX metal forming simulation.

For an analysis model, it is possible to run normal simulation successfully only if there are no 'surface open' or 'non-manifold' errors. Previous version does not provide the feature which detects non-manifold errors, so that there were cases where unknown errors occurred during simulations.

Now, in AFDEX V24R01, one can check the non-manifold error in a 3D STL model with the error as shown in Figure3.2 (b). By contrast, Figure 3.2 (a) shows that there are no errors when importing the STL file with the non-manifold errors.



(a) Before improvement



(b) After improvement

Figure 3.2 Error detection in 3D simulation model

3.3 Overheating Prediction on Dies during Shape Drawing Process Simulation

In most metal forming processes that include forging, frictional heat is not an important factor, although friction itself is important. Therefore, most of the forging simulations do not pay attention to frictional heat. However, it becomes completely different situation in drawing process. In drawing process, a material generates relative motion such as slippage with dies, maintaining continuous contact with a certain part of a drawing die. In this case, lubrication for drawing and additives are widely used. However, there are limits of lubricants to solve the die overheating problems that can occur during the shape drawing, depending on the situation.

In AFDEX V24R01, users can control the frictional heat and predict the die overheating phenomenon (Prediction of friction heat ball) during the circular- and half-circular shape drawing process, using the feature that one can enter a temperature-dependent friction coefficient which is provided in AFDEX.

Figure 3.3 illustrates the overheating of a die caused by the frictional heat generated in narrow space, which occurred 5 seconds after the start of drawing. (Maximum temperature: 160℃) Considering the actual elapsed time of the process and a vicious cycle of frictional heat, temperature rise, and friction, the maximum temperature can increase significantly.

This overheated friction heat ball rapidly increases the surface temperature of the inflow of a workpiece, causing a rapid temperature softening of the flow stress at the surface of the workpiece. This can cause skin flow, and as shown in Figure 3.4, overlapping defects that are not understood by common sense can occur at the edges where are deformed. The phenomenon is more likely to occur in high-strength and high-temperature softening materials.

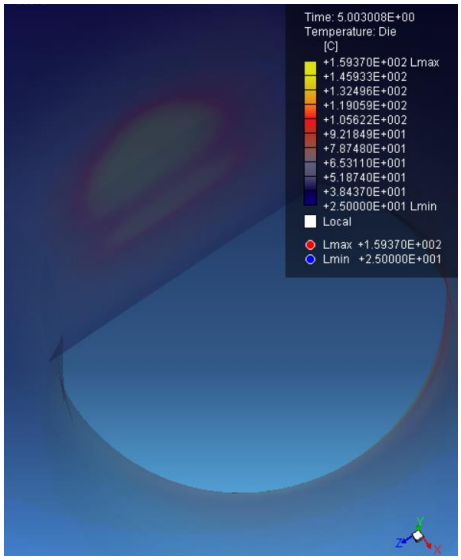


Figure 3.3 Overheating caused by friction at a drawing die

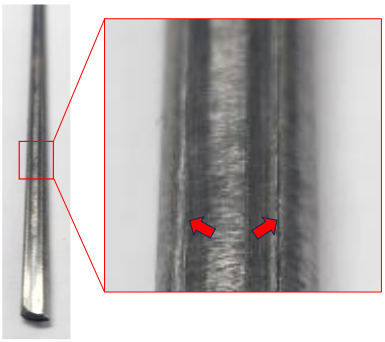


Figure 3.4 Folding occurred during circular- and half-circular shape drawing process

4. Notice

4.1 AFDEX Online Training Session on the Altair Learning

The AFDEX online training session was held for Altair Partner Alliance (APA) users who will conduct a forging simulation in the future through Altair Learning on October 30th and 31st, 2023. The training covered various examples, including the introduction to AFDEX, 2D/3D multi-stage cold/hot forging process simulations, material identification, as well as pre- and post-processing. The agenda below provides an overview of the topics that were covered.
(https://learn.altair.com/course/view.php?id=454)

4.2 Online Training in 2023

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)