AFDEX Newsletter
2017 Autumn

MFRC
Tel: 82-55-854-7529 Fax: 82-55-854-1837
www.afdex.com, mfrc@afdex.com

1. AFDEX_V18R01

AFDEX_V18R01 will be released on February 01, 2018. Key features of this version are the addition of heat treatment and microstructural evolution functions and drastic improvements in computational speed. Early adopters can use it from December 01, 2017.

1.1 Heat treatment analysis

The AFDEX - HT module will be newly released on 1st December 2017 in AFDEX_V18R01. Figure 1.1 shows an analysis of the Jominy test using a 2D/ 3D heat treatment function. As shown in figure 1.2, both 2D and 3D simulation results are very similar. Even though it is an abrupt heat transfer simulation, it is possible to predict a stable temperature change in both 2D and 3D. Also, in the new AFDEX-HT version, the hardness value can be predicted as shown in Figure 1.3.

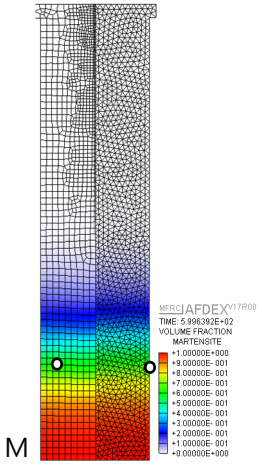


Fig. 1.1 Predictions of Jominy test for heat treatment.
Left for 2D and right for 3D (Color shows the martensite fraction)

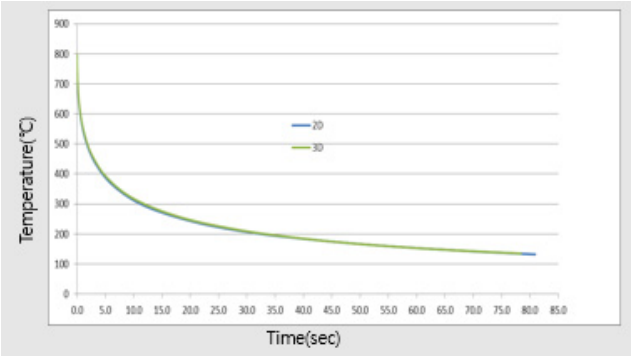


Fig. 1.2 Temperature prediction at point M (2D and 3D analysis)

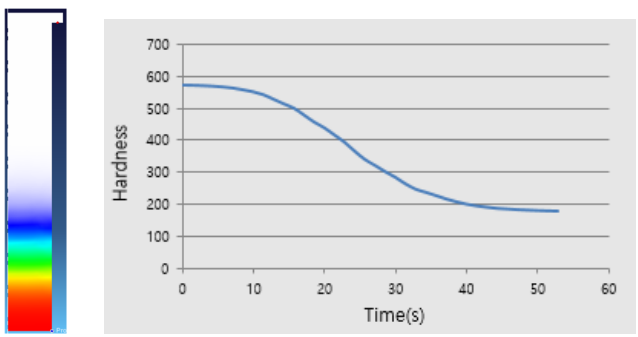


Fig. 1.3 2D simulation result of Jominy test (Hardness)

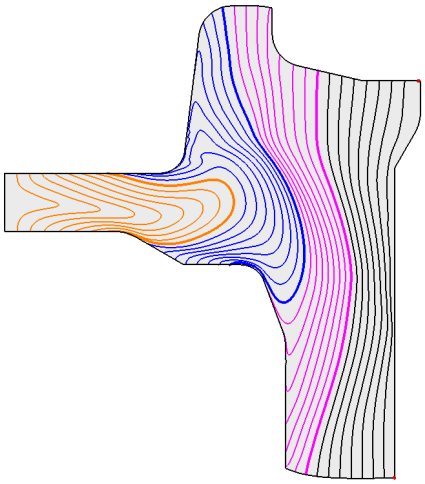
1.2 Quality indices of metal flow lines

The metal flow (grain flow) lines have a significant effect on the life of the forged product. According to research (Ito et al.), the tests on tapered roller bearings indicated that products with good metal flow lines have up to 6 times longer life than products with unstable ones. It has been well known (See conference book of MFCAE 1996, edited by M.S. Joun) that SKF bearings strictly require the symmetry of the first-generation hub bearing outer race.

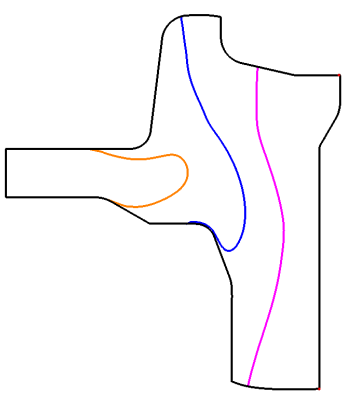
Until now, there was no other way to determine the quality of metal flow lines. This problem has been a great obstacle to optimize the design of the metal forming process using the metal forming simulator. In other words, when defining the process design optimization problem, it was not possible to treat metal flow lines directly as an objective function or constraint.

Recently, the quality indices of these metal flow lines have been developed, including the density function of metal flow lines and the its overlapping index. Figure 1.4 shows an application example, and the same method applies to both the two-dimensional and the three-dimensional cases.

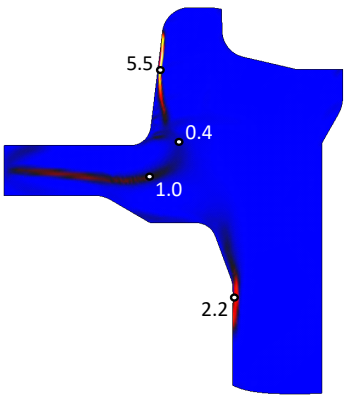
It should be noted again that these indices are essential for process design optimization because the grain flow should be considered first to manufacture the quality forgings.



(a) Metal flow lines



(b) Density function



(c) Overlapping index

Fig. 1.4 Metal flow lines and quality indices

1.3 Innovation in AFDEX structure

Recently, the fundamental structure of AFDEX program has been enhanced greatly for supporting various changes of functions and improvement of computation efficiency. In other words, AFDEX has a single program structure that is systematically combined with mechanical, thermal and material engineering analysis functions. As a result, improving new features will be accelerated, and reduction will be made in terms of calculation time. In the next version, significant progress will be made in terms of analysis of very large problems, process optimization, metallurgical analysis, and high-speed calculation.

1.4 Improved computation speed

Through the program structure modification and optimization, the calculation speed will be improved drastically in the next version. At present, the calculation time for a typical non-isothermal analysis problem is about 70% less than in the past. This will serve as an opportunity to enhance the utility of the program and to improve the process optimization function and improve the applicability.

As a result of testing through the example, the calculation time for the non-isothermal problem was reduced by more than half compared with the previous version. The test process to verify the optimization is the upsetting process, which consists of a dwelling process and forging process. The test includes flow analysis, temperature analysis, and die structural analysis by AFDEX 3D. It took 50 seconds to solve the problem, and the previous version took about 140 seconds of calculation time. This is being researched upon currently to further reduce the computational time. In the future, the simulation time will be continuously reduced due to the improvement of the speed of re-meshing and the improvement of some subroutines.

On the other hand, the previous AFDEX has some computational advantages in terms of the calculation of the metal flow lines, the automatic analysis function of the multi-stage process, and the simultaneous multi-analyses function in a computer.

2. Main events

2.1 MFCAE 2017

MFCAE 2017 organized by Gyeongsang National University was held at Changwon Pullman Hotel on August 17th and 18th. A total of 15 oral presentations and 97 poster presentations took place. More than 120 people including AFDEX developers attended this event to present their outstanding achievements and to discuss further directions of AFDEX development. Since its inception in 1996, MFCAE has been leading the technological development of Metal forming CAE and the utilization of industries through 17 events and has contributed to the development of the industrial forging technologies.

Fig. 2.1 MFCAE 2017

The conference proceedings of MFCAE 2017 were published for educational purposes of metal forming simulation technology under the title of "Metal Forming Simulation – Theory and Application (Ed. Joun, Mansoo)" by Jinsaem Media in Korea. Eleven researchers contributed to its publication, including Prof. W. J. Chung (SNUT), S. M. Hong (KNU), K. H. Lee (PNU), Y. Shin (Purdue University), D. H. Yoo (POSTECH), M. S. Joun (GNU), S. H. Chung(MFRC), and 4 researchers working for MFRC or GNU.

2.2 GISPAM 2017

For one month from 17th July, GISPAM 2017, a special summer program for AFDEX, etc. was held for a scholar and 20 university students of the State of Mexico, 2 Mexican engineers, 6 GNU students and 2 Malaysian students in the Gyeongsang National University(GNU) and the Korean Mold Education Center. The program includes some selected lectures on solid mechanics and heat transfer, practice of engineering softwares such as AFDEX, AnyCasting, etc., and industry and culture tours.

This GISPAM is the fourth international student exchange program, financed by the State of Mexico and related industries.

Fig. 2.2 GISPAM 2017

2.3 Special sessions of KSTP Fall Meeting 2017

On October 19 and 20, the Korean Society of Plasticity Engineering Fall Conference was held in Jeju. At this conference, research and application using AFDEX were presented through two special sessions. In addition, a total of 16 papers were presented through general oral presentations and poster presentations.

The topics of the papers presented includes quantification of grain flow, complete analysis, verification of heat treatment by Jominy test, surface hardening simulation, optimal design of three-dimensional forging process, precision simulation of heat transfer using skin elements, fracture prediction by tri-axial stress criterion, prediction of die life, high-speed radial forging simulation, material identification for microstructural evolution based on optimization technique, frictional phenomena in aluminum cold forging, practical simulation of plate forging process, etc.

The key proceedings will be uploaded soon in the AFDEX homepage.