

THE ACTIVITY FOR THE TIME REDUCTION OF POST-PROCESSING OF CAE ANALYSIS RESULT IN THE DEVELOPMENT OF AUTOMATIC TRANSMISSION PRODUCTS

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KEYWORDS –

Strength/Stiffness, Automatic Transmission, μ ETA, Python Script

ABSTRACT –

Recently, the further time reduction of analysis process has been a huge demand due to increase in CAE needs and CAE model size. AW-E has CAE department and one special team that were created several years ago. The team has been working to improve the work flow. In this report, we pick up a post-processing of Strength/Stiffness analysis that has the highest workload in AW-E. Then, we explain from the background of this activity, automated function we developed, and the benefits by this activity as a summary.

TECHNICAL PAPER -

1. OUTLINE

The works of AW ENGINEERING CO., LTD. (AW-E thereafter) are development, design, and evaluation support using CAE analysis and measurement evaluation system development. AW-E is a partner of AISIN AW CO., LTD. which is specialized in automatic transmission for automobiles.

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2. BACKGROUND

AW-E is preceding further technical innovation in order to succeed bran-new development process, “Virtual Engineering” utilizing the state of the art technology of CAE on the product design, the process design, and the evaluation of measurement.

Recently, due to the increase in CAE needs and CAE model size, it is a big subject how we can submit the CAE post-processed result on time. So, the time reduction of post-processing is highly necessary. In order to solve this kind of problem, AW-E founded the special team to be able to focus fully on this activity.

Our CAE works are very wide which covers Strength/Stiffness, Thermal fluid, Vibration, and Multi body dynamics. For each area, we did a lot of activities to improve efficiency for CAE modelling, Load-case setup, Solving and Post-processing. In this paper, we introduce one the efficiency improvement for Post-processing of Strength/Stiffness analysis.

3. OPTIMIZATION OF POST-PROCESSING

On the post-processing of automatic transmission analysis, a large number of images and values have to be extracted on a large number of places of CAE model. It also needs a huge amount of man-hour and may cause a large amount of errors without consciousness. At AW-E, we utilize a commercial post-processor and extract the notable result data from a large amount of the analysis result, and make an Excel report with these data to submit to the customer. In order to create this workflow, our post-processing system needs following functions.

- 1) Highly customizable
- 2) Direct Excel report generation

Then, we developed a fully automated system which is configured by the following functions.

- 1) μ ETA Script: To extract images and values
- 2) In-house software: To generate Excel report
- 3) In-house software: To combine above functions

Structure of the system

In order to materialize automated workflow of CAE post-processing, we developed the internal software to issue the calculation job on the calculation server and to download the analysis result onto local PC, the script function of μ ETA to create images and extract values, and internal software that creates report in Excel. We also established the in-house software that all software is managed and executed at once. (Figure1)

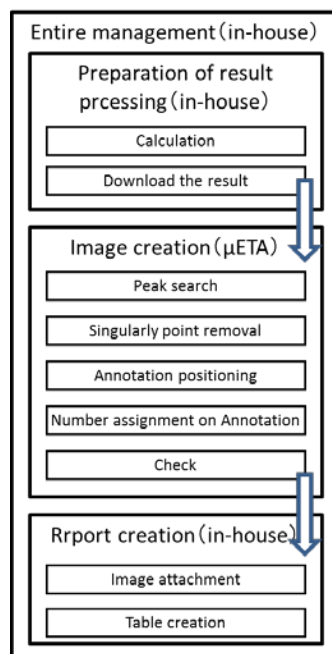
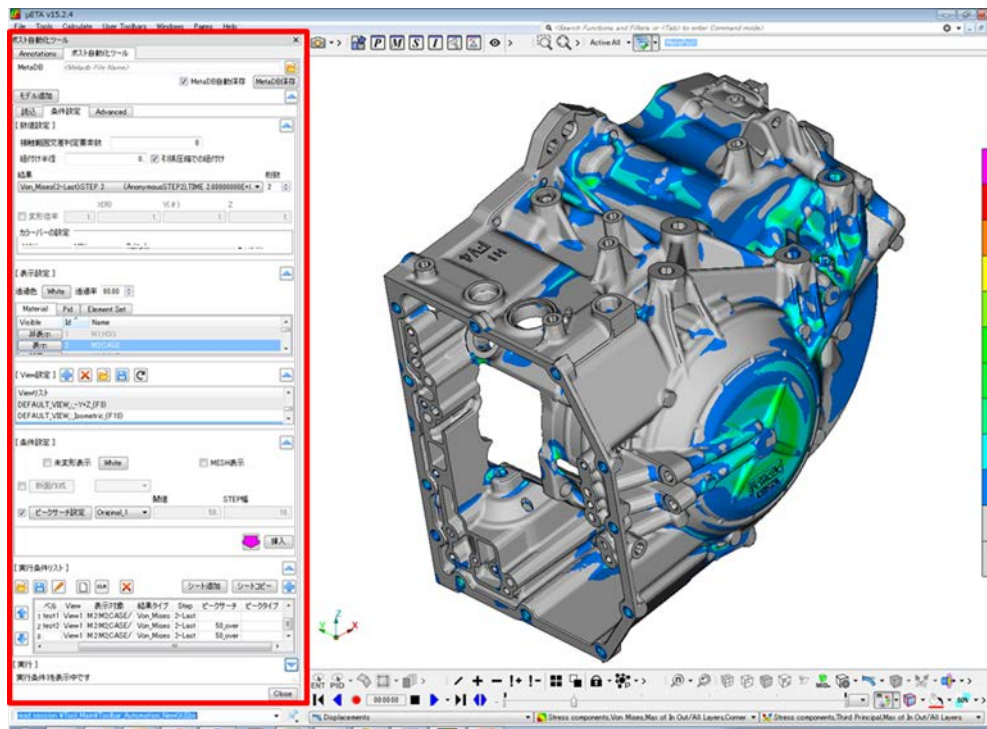


Figure 1 – System Structure

How to use the system

This system is in the server and it is called from μ ETA user toolbar. On the left side of “Figure 2”, the operation and setting which are contained in the system can be done from GUI, created by μ ETA script. Model data and analysis result are read from GUI and the set-up for the setting to extract notable values and to create images is done on GUI.

For the first time, user needs to set up for the number of images he/she wants to create. The settings can also be saved and read. Therefore, it is unnecessary to set up manually again for similar analysis. As a result, we succeeded to reduce the man-hour. After settings, just by clicking Apply button, the images and values are extracted automatically.

Figure 2 – Customized GUI in μ ETA

This system automated the entire process from analysis calculation to report creation. Even in this case, when the system is called from μ ETA, the user needs to select the model file and reads settings and executes the system. So, the entire process, from execution of calculation to report creation, is executed automatically. Therefore, when the user leaves the system to run until it finishes, he/she can confirm the report on the next morning.

Peak search

Note that 3 terminologies are used in this report. “Peak” indicates that the result value on node is higher than the other nodes around it. The area around “Peak” should be the notable evaluation area. “Singularly Point” indicates that the result value on node is extremely high with the set-up LOAD CASE or SPC. However, it should not be considered to be used as evaluation value. “Annotation” means that the “Peak” label is an arrow that indicates the “Peak” node. This “Annotation” has the number which will be used to be mapped with a result list in the final report.

On the post-processing, Peak value should be extracted and displayed in Annotation. By manual operation, the user needs to find Peak node, get the value, paste the model image on the Excel report and create Annotation on Excel. Because the manual operation processes is complicated, a large number of errors could happen. This is the reason why the fully automated function was developed.

Refer to “Figure 3” that explains the Peak extraction. Point A, B, C, D and E are the candidates for the Peaks. Between A and B, there is no canyon. So, A should be ignored. E is the Singularly Point. Therefore, E should also be ignored. From “Figure 3” Point B, C and D are considered as Peaks.

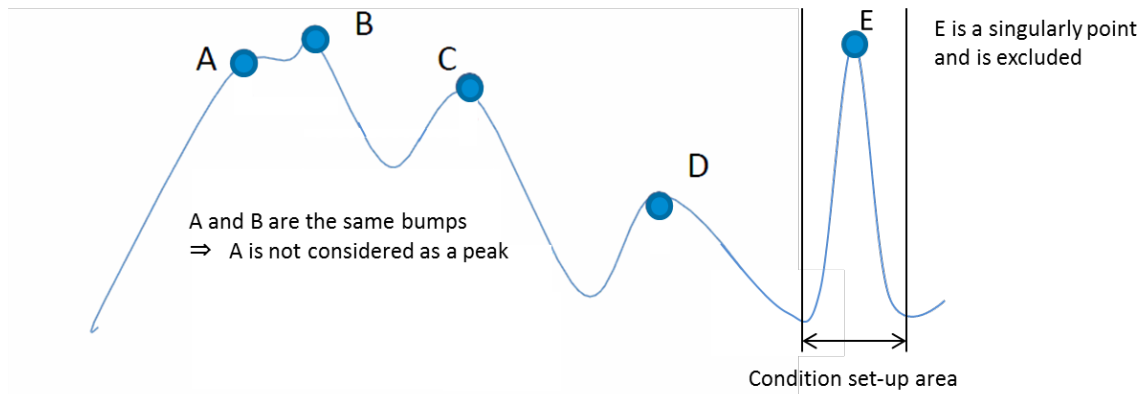


Figure 3 - The peak extraction

μETA has the function, called “Advanced Filter” which extracts the entities that matches the set-up condition. It is possible to extract prospective Peak nodes. However, to extract only the desired Peaks, the extremely complicated settings and multiple executions need to be done. Considering the processing time, it is not realistic. Therefore, with the individual logic, we developed the peak search function. For Singularly Point, it is acquired from the Load Case set-up of the model data. The peaks within the set-up are excluded. As a result, all desired Peaks are automatically extracted and omission is eliminated.

Creation and location of annotations

Annotations are automatically created for all extracted peaks after searching for peaks, utilizing μETA annotation function. “Figure 4” shows an example. During creation of annotation, image creation into the report and Peak list generation are executed simultaneously. Then, omission is eliminated.

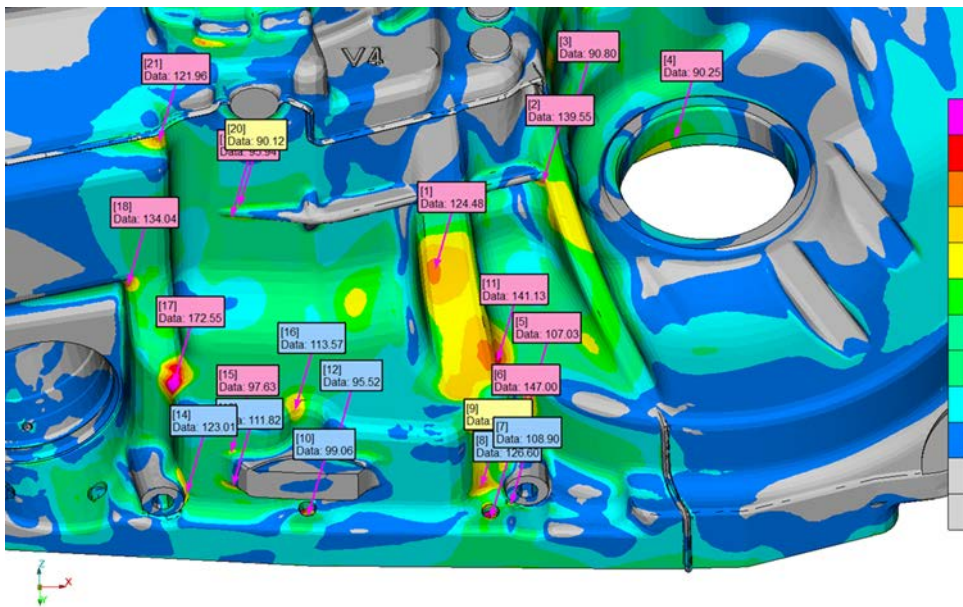


Figure 4- Annotations of the result of peak searching

Annotations placed by μETA positioning, can be on top of the others. Then, the reposition of Annotations is necessary. For the repositioning, there are 3 rules.

- 1) No overlap with other Annotations
- 2) No hidden Peak by Annotation
- 3) No intersection of arrows

Since there are more than 10 Annotations like “Figure 5”, the manual repositioning operation took a large amount of man-hour.

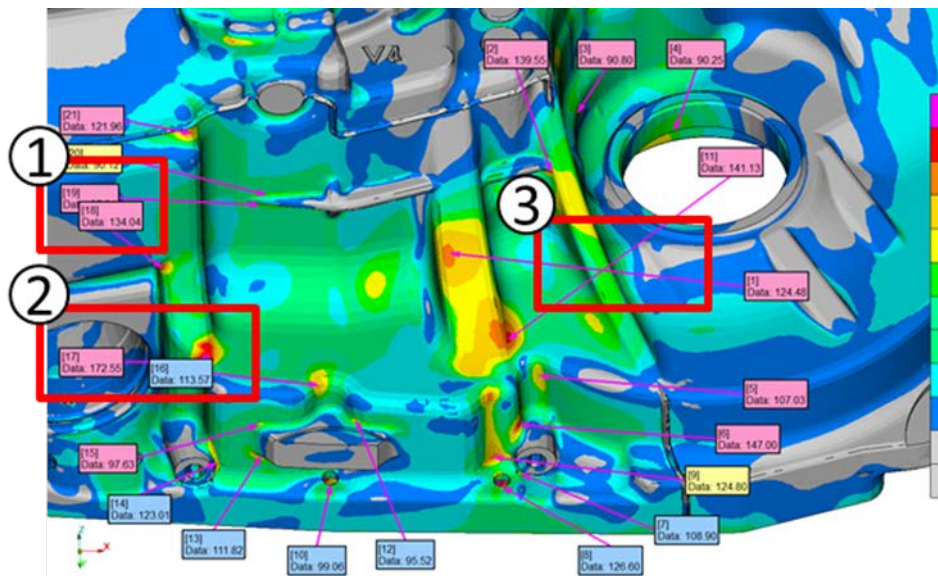


Figure 5 - Annotation positioning by manual operation

To reduce man-hour and to create a readable report, we developed an automated positioning function. With this function, even for a large number of Annotations, above 3 rules are met and be man-hour is significantly reduced. “Figure 6” shows an example.

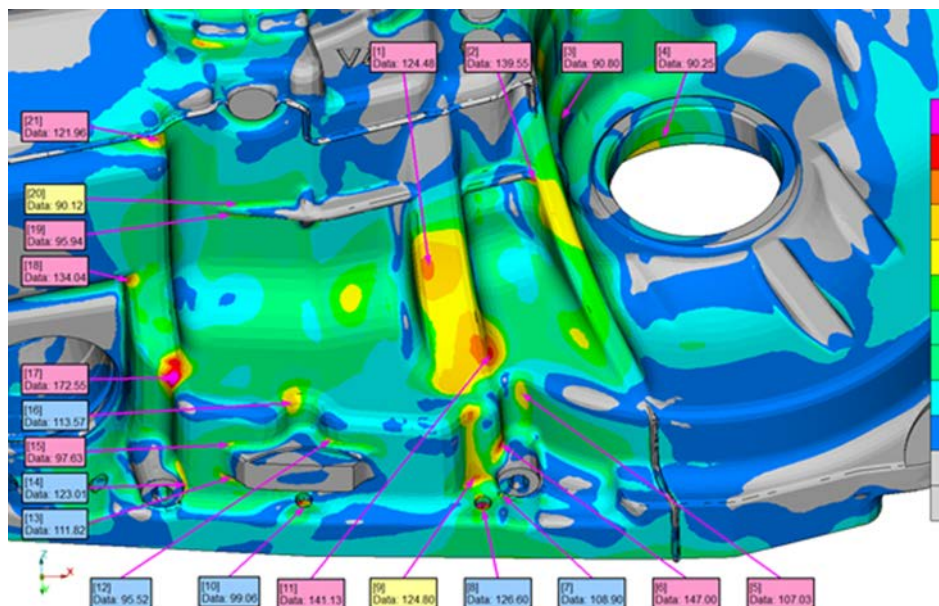
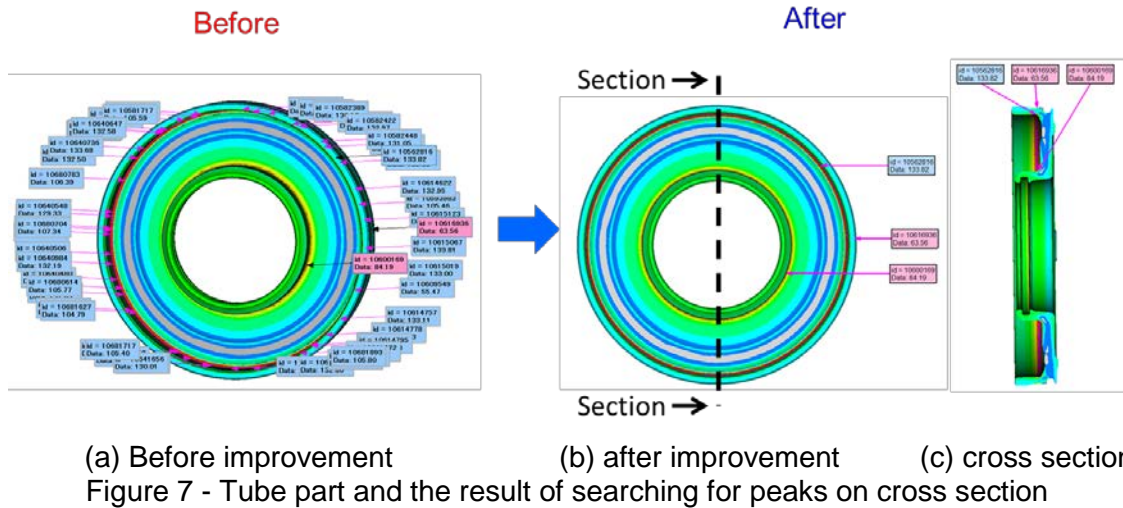


Figure 6 - The result of automatic positioning of annotations

Peak search on circular part and cross section

In the case that a circular part is a target part for searching, a large number of Peaks can be attached on the same circumference due to a margin of analysis like Figure 7-(a). In the real life evaluation, only one largest value is necessary on the same each circumference. Other values can be deleted. Therefore, we improved the auto-search function to be able to extract and annotate only the peak with largest value by giving a function that specifies an axis of rotation center. Figure 7-(b) shows an example.



Moreover, for the circular part, the cross section can be shown with the image. In this case, instead of placing Annotations on an actual position, it is positioned where the Peak node is reflected rotationally on the designated cross section. In order to generate this kind of sectional Annotations, we modified the function by just specifying an axis of rotation center. Figure 7-(c) is an example.

On post-processing by manual operation until now, because Annotation generation on a cross section took a large amount of man-hour, this operation was skipped as much as possible. However, because of our system, it is done automatically. So, for the circular part, the analysis standard is modified to surely create the cross section Annotation.

4. CONCLUSION

Due to the activity in this report, AW-E succeeded to automate the post-processing of Strength/Stiffness analysis which has been done by manual operation most of the time in the past. Also, due to the reuse of the setting specification, it is now possible to automatically execute the whole analysis process from calculation to report creation.

AW-E successfully reduced the man-hour up to the maximum of 80% using this system.

Also, the analysis result report is submitted to the engineer at a shorter time.

AW-E performs the wide analysis in fields, like thermal fluid, vibration, mechanics, and Strength/Stiffness analysis. From now on, we plan to perform a wider variety of automation and efficiency.

5. ACKNOWLEDGEMENT

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