Cutting Method of the CAD model of the Nuclear facility for Dismantling Simulation

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1. Introduction

The dismantling of nuclear facilities takes a very long time and is a dangerous procedure. So that it should be going through the process optimization procedure based on the process simulation. The process simulation pre-evaluate the operation time, cost and check the possibility of danger of the dismantle procedures so that it enhance the safety of the dismantling.

Current methods for process simulation cannot simulate the cutting operation flexibly. As is, to simulate a cutting operation, user needs to prepare the result models of cutting operation based on pre-define cutting path, depth and thickness with respect to a dismantle scenario in advance. And those preparations should be built again as scenario changes. To be, user can change parameters and scenarios dynamically within a simulation configuration process so that the user saves time and efforts to simulate cutting operations.

This study presents the methodology of cutting operation which can be applied to all the procedure in the simulation of dismantling of nuclear facilities.

2. Model cutting Methods

To simulate the cutting operations flexibly, we created a methodology to cut the 3D CAD model in the context of the Delmia [1] implementation environments. And to apply the methodology to the simulation of the dismantling of nuclear facilities, it should satisfy the following requirements.

A. Express exact shape of Cutting Geometry (shown in Fig. 1) and cut geometry (shown in Fig. 2) of the target model
B. Predict the second wastes during the cutting operation
C. Ensure stability during multiple cutting operations

To express the shape of Cutting Geometry and cut geometry of the target model, we modeled Cutting Geometry based on shape of cutter and moving path of the carrier in 3D CAD environments. And we performed a Boolean remove operation between Cutting Geometry and target model. So that we can get the cutting result of target model which express the volume of the cut geometry visually.

To predict the second wastes, we performed a Boolean intersection operation to get the intersection volume between Cutting Geometry and target model, and also we can get the weight of the second wastes from the intersection volume with the density of the target model.

In general, a CAD model contains the specification information (modeling history and feature information). Specification information makes user easily change the shape of the model by changing the parameters. However, the size of the specification information increases as much as operation performed during the modeling procedure such as Boolean operations. It can be a problem in the cutting operation of the nuclear facilities, because nuclear facilities are huge and it needs to cut more than a hundred times. So that it may occur instability of cutting operations.

To ensure stability during multiple cutting operations, we only used geometrical information without specification information.

3. Implementation and Result

Implementation environments are shown in Table I.

Table I Implementation environments

	Environments
OS	Window 7 x64
Language	C++
Simulation-SW and Library	Delmia V5R21 and CAA
IDE	Visual Studio 2008 and RADE

Delmia is process simulation software developed by Dassault System which is widely used for process planning, process improvement and verification [1]. CAA (Component Application Architecture) is an API (Application Programming Interface) of the Delmia, and it provides the platform independent development environment. RADE (Rapid Application Development Environment) is CAA application programming tool for the Visual Studio.
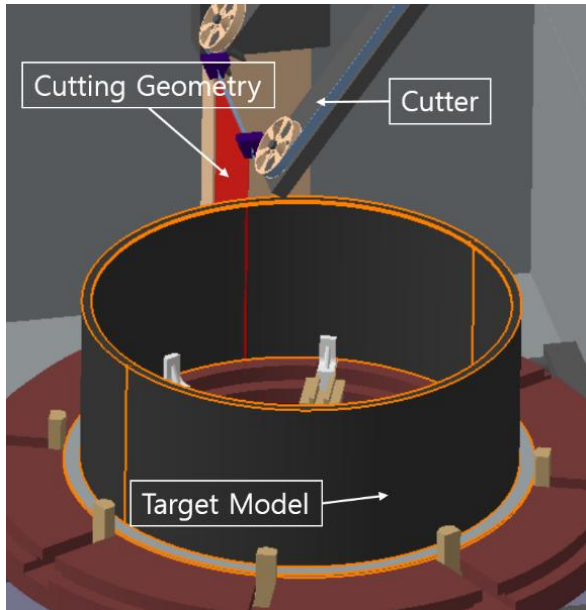
Fig. 1. An Example of the cutting simulation

An example of cutting operation is shown Fig. 1. In Fig. 1, the target model is cut by Cutting Geometry of a band saw. The Cutting Geometry of the band saw is modeled based on shape and moving direction of the band saw.

Simulation is performed based on the configuration shown in Fig. 1, and we can get the cut result (cut geometry) as shown in Fig. 2. In Fig. 2, cut geometry of target model is shown in the box with dashed lines.
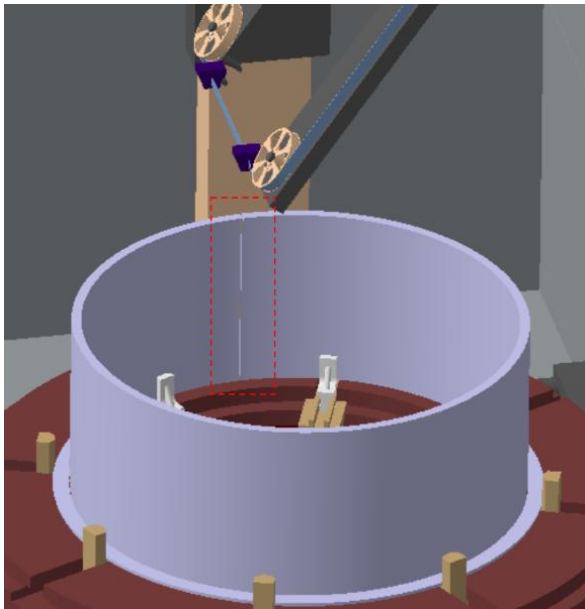

Fig. 2. Cutting simulation result

We developed the cutting simulation module for cutting operation using circular saw, hydraulic cutter and water jet cutter, which can be used in dismantling of nuclear facilities, As well as band saw case shown in Fig. 1 and 2.

3. Conclusions

In this study, we developed the cutting simulation module for cutting operation in the dismantling of the nuclear facilities based on proposed cutting methodology. We defined the requirement of model cutting methodology based on the requirement of the dismantling of nuclear facilities. And we implemented cutting simulation module based on API of the commercial CAD system.

REFERENCES

[1] G. Ryu, et al., Guidance weapon assembly simulation using the DELMIA. KSAS Conference 2008, Vol. 2, p. 1220-1223, 2008