Attribute Information Assignment to the Point Group Data of Machinery and Equipment and Construction of 3D Modeling Method

(Research period: FY2019 to FY2020)

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key words: machinery and equipment, point group data, CIM

1. Introduction

With regard to the reduction of creation effort, which is an issue in CIM (Construction Information Modeling/Management) for civil engineering machinery and equipment, this research has specifically indicated, using the level of detail as a scale, "how much creation effort should be made" based on the assumption of applications in each stage from the planning and design stage to construction and maintenance.[1)] However, if you want to use a 3D model for existing machinery / equipment, you have to model it from scratch if there is no existing model, but the reality is that there is little incentive to do so because much labor will be required.

At present, point group data using laser scanners is used in the finished-shape management of ICT-applied construction projects, and point group data is also utilized in the maintenance of private machinery plants. Since the technological progress of laser scanners has enabled easy acquisition of highly accurate point group data, this research proposes a method to assign attribute information to point group data for maintenance and a method to construct a 3D model based on point group data.

2. Attribute assignment to point group data

For roads, the "Attribute Management Specifications for Point Group Data [Road Part] (Draft)" (the "Standard Specifications") has been proposed and published to serve as the foundation for the distribution infrastructure of 3D data utilizing the accumulated point group data. [2)]

The Standard Specifications define point group metadata (text data that defines how the data was measured, location, accuracy, etc.), area data (text data that defines the shape of external area (location and range) where any structure, etc. exists), and file data that manages multiple area data. Each definition file is in XML format, and the point group editor software that can read this file can recognize the structures included in the point group data and assign the necessary attribute information without processing the point group data itself. This research, focused on the point group data of drainage pump stations (**Fig. 1**), studied a method to specify the area of main equipment, assign and manage necessary attribute information, using 3D Point Studio[3)], point group editor software that conforms to the Standard Specifications.

Fig. 1: Point group data of drainage pump stations

In designating the areas of main equipment such as main motor and reduction gear, the area data file was constructed with reference to the method of designating "features" in the Standard Specifications. As a result, it was possible to specify the area as a simple cube as shown in **Fig.2**, and in 3D Point Studio, it was also possible to display the specified area separately and assign attribute information as shown in **Fig. 3**.

Attribute information that complies with the "CIM Introduction Guideline (Draft) Part 7: Machinery and Equipment" (MLIT) could be assigned to the area data file for each of main equipment. However, the current software has some room for improvement in usability, such as the inability to specify areas according to complex shapes such as piping.

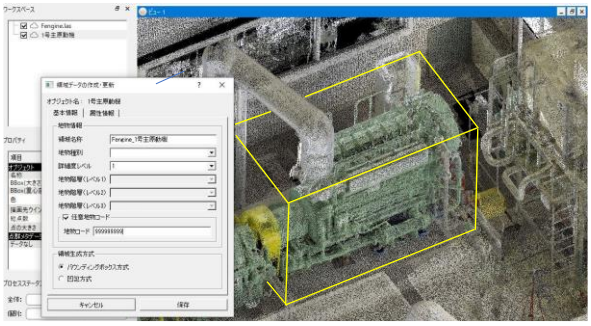

Fig.2: Designation of the area of main motor

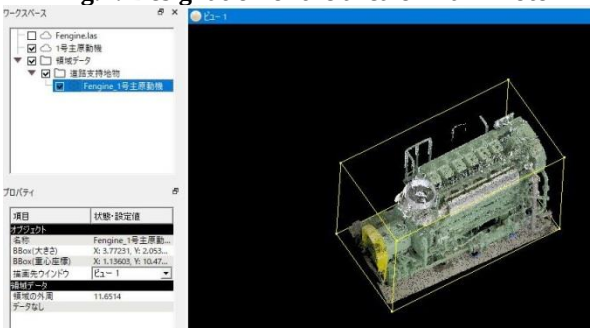

Fig. 3: Separate display of areas (main motor)

3. 3D modeling of point group data

3D modeling of point group data is commonly used in the private plant management and shipbuilding industry, and multiple packages of dedicated point group editor software have been developed. The key to software selection is the modeling of piping and the generation of surfaces (especially complex shapes such as motors and reduction gears), and there is a difference in effort and precision depending on the functions of the software used, especially when creating models with a detail level of 400 that can be used for maintenance. **Fig. 4** shows an example for creating a 3D model with a detail level of 400 based on point group data shown in **Fig. 1**. In this example, main motors and reduction gears with a detail level of 400 were made using the software that can model parts from point groups.

On the other hand, we also tried to use a point group editor that can automatically output surfaces (polygons) from point group data. Although it is advantageous in terms of labor, there are some characteristics, such as necessity for modification of automatically generated surface and difficulty in modeling at the component level. For piping, it was found that although many software programs can automatically generate piping materials and valves, there are differences in the creation method and the accuracy of models. Accordingly, in modeling, it is necessary not only to clarify the purpose and scope of modeling and then determine the level of detail, but also to evaluate the effort and the accuracy of model to determine the point group editor software to be used.

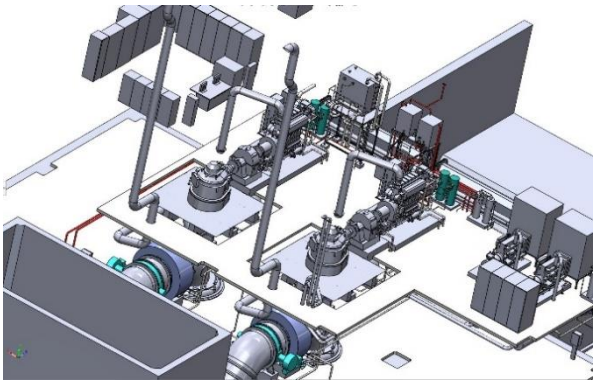

Fig. 4: Example of 3D modeling using point group data

4. Utilization method

Since the point group data includes color information, piping can be easily identified and the situation close to actual situation can be grasped. By assigning and managing attribute information, it can be used widely for everyday facility management operations.

The 3D model created from the point group data can easily eliminate deviations from the site that may occur in 2D drawings, and depending on the method of creation, the model can be deformed, which is a great advantage in maintenance and design for renewal of existing facilities, construction planning, etc.

5. Conclusion

The results of this research project and issues related to software will be compiled and disseminated to facility managers and related parties in industry and academia.

☞See the following for details.

1) Points of attention in creating a mechanical equipment CIM model (by level of detail)
http://www.nilim.go.jp/lab/pfg/bunya/mecha_cim/mecha_cim.html

2) Attribute management specifications of point group data [Road Part] (draft)
http://www.nilim.go.jp/lab/qbg/standards/standards.html#road-data

3) 3D Point Studio Official homepage
http://www.pointstudio.jp/