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A Study on Model Exchange Technology for Large Scaled Structure CAD Applied to Cross-Reality Contents Authoring

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Extended Abstract

Large-scale structure manufacturing, such as ships, offshore structures, and production plants, differs from other manufacturing industries in that there is only one project per design model. There are often many instances where multiple 3D solutions are required throughout the lifecycle of a single project. However, multi-site and remote collaboration has become common, and it is difficult for all stakeholders to possess expensive solutions. Furthermore, in the large-scale structure manufacturing industry, design and production information needs to be continuously utilized even after the production of the structure, for operation, retrofit, reopening, and disposal. However, the limitations of design models with a dependency on specific solutions make it difficult to directly utilize them in a digital twin environment for design reviews, production reviews, and operations. Currently, for such utilization, relevant content is created by extracting only the necessary parts through post-processing depending on the situation. This means that each time there is a need, time and cost must be invested in extracting and converting the model, indicating that continuous time, cost, and manpower are required to use the design model outside of the specific solution. In order to improve the difficulty of such utilization, research on CAD model exchange technology is needed to develop content authoring technologies that allow the design information of large-scale structures to be utilized in various application environments.

Regarding design model extraction and exchanging, there are cases of utilizing the ISO 10303[1] standard for shape information exchange and, using XML design model information sharing including partial catalog data in relation to data exchange in shipbuilding and plant CAD systems[2]. In the previous two cases, standardized information exchange is possible by using pre-defined standard formats, but additional integration is required for databases that exist independently, such as the linkage between shape information and catalog data. Furthermore, considering research cases on extracting pipe model from CAD system using neutral formats for AR model[3] and structural model exchange[4], a systematic definition of a common extracted design information structure is necessary.

In this study, the process of defining the model exchange architecture between three CAD systems: AVEVA E3D®, HEXAGON PPM Smart3D®, and AUTOCAD PLANT3D®, was carried out. Data structures and interfaces for authoring content for external systems such as metaverse, virtual reality, and augmented reality were defined, and based on this, tests were conducted using the exchange technology for structural, piping, and equipment models included in the design model to evaluate its applicability in industrial settings. The aforementioned large-scale structure design systems exist in a database structure, and to exchange data between them, graph database technology was utilized to interconnect shape information, attribute information, catalog information, and other relevant data from each system. The extracted model data was configured into neutralize into a format that enables exchange between CAD systems, and this neutral format included essential data structures necessary for mapping information for rapid authoring of virtual reality and augmented reality content. A prototype incorporating the developed model exchange technology was constructed, and its validity was verified through model extraction and authoring tests.

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