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Development of Mobile Welding Robot Motion Software for Large-Scale Environment Welding

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***Abstract*—Tank manufacturing for LNG ships is currently mostly manual work due to the size and difficulty of the work. Research on the automation of LNG cargo production using a mobile welding robot is in progress. In this study, software development that determines the operation of a mobile welding robot is introduced.**

***Index Terms*—Mobile manipulator, Template based motion, LNG Cargo, Robot welding.**

I. Introduction

An LNG cargo tank is a vast room occupying most of the LNG carriers, as shown in Fig. 1. The size of it is usually enormous, reaching 20M or more in height, 20M in width or more, and 30M or more in depth. This large LNG cargo tank is manufactured by welding the membrane module. The size of membranes varies. On average, it is 3,000mm wide and 1,000mm long. Since roughly 2,000 membranes are used in one LNG cargo tank, it takes several months to produce. Making an LNG cargo is as tricky and complex as its size. Most of the process is done by hand, so it takes several months to produce just one LNG cargo. There were studies on offline programming methods for laser welding on complex objects regardless of application, such as [1], [2]. However, there is no case of applying offline programming software for mobile welding robots to automate the welding of large-area LNG cargo tanks worldwide. Therefore, this study introduces the development of mobile welding robot motion decision software for welding large-scale targets.

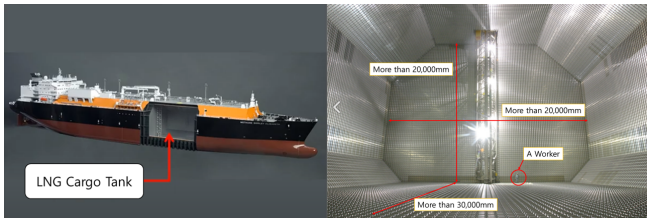

Fig. 1. The left figure shows a general LNG ship. The right figure shows a cargo tank. Generally, a ship has 4-6 tanks.

II. Software Development for Mobile Welding Manipulator

What differentiates the developed product from the existing offline programming software is that the target robot is a mobile manipulator, and the work area is huge, so it is a complex motion including movement and welding. The developed software reads the CAD of the work target and identifies the membranes that make up the LNG Cargo like

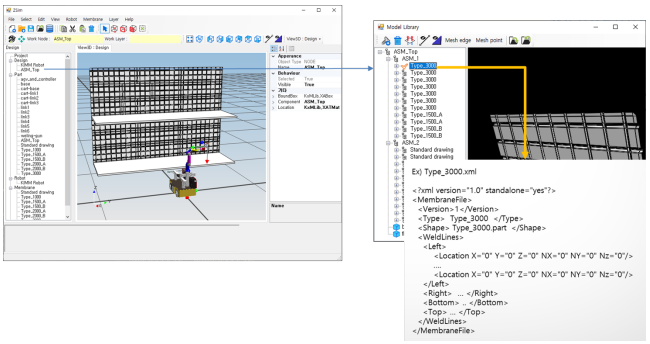

Fig. 2. Developed mobile welding robot motion decision software

Fig. 2. For the identified membranes, there is a predefined db, and detailed operations for welding the four sides of the membrane are written in the DB. This detailed operation is a robot operation that guarantees the quality of welding through a separate experiment for each membrane. After moving, the mobile welding robot determines the workable area with a predefined length at the stop position and adds the membrane within the area to the work target list. The robot's work order is determined through an optimal path generation algorithm for the added membranes.

III. Conclusion

Mobile robot motion determination software for automatic welding of LNG cargo, which is a large-scale welding target, has been developed.

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