Development of a Simulator for Off-Line Programming of Gantry-Robot Welding System

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Abstract

Welding automation is one of the most important manufacturing issues in shipbuilding in order to lower the cost, increase the quality, and avoid the labor problems. Generally the on-line teaching is utilized on the robot that is used in the welding automation system, but it requires much effort and long time to program. Especially, if the system is composed of more than two cooperating robots, it demands much more skill to program the robots' motion. Thus, a convenient programming tool is required for efficient utilization of welding automation system. In this study, a convenient programming tool is developed for welding automation in which gantry-robot system is used. The system is composed of a gantry transporter and two robots mounted on the gantry to cover the wide work range in the ship building application. As a programming tool, an off-line programming software based on PC is developed. By using this software, field operator does not need to concern about coding of task programs for three control units, one is for gantry and two are for robots. The task programs are automatically generated by assembling the program modules in database according to geometrical information of workpiece and welding condition, which become the only concern of field operator. The feasibility of the generated programs can be verified via a motion simulator previously to on-line running.

1. Introduction

Recently, the welding task in the area of heavy industry like ship building is being automated by using robots. The general welding robots used in such an automated welding system, basically have an on-line programming tool like teaching-pendant. This kind of tool is inefficient because of inherent complexity of on-line teaching. In the case of the welding application in shipyard, It is more serious.

The configuration of the automated welding system and workpiece used in this paper is shown in fig. 1. The workpiece is steel bridge block which is assembled in a shipyard. It composed of a main plate and a lot of stiffeners. The size and shape of main plate and stiffeners are not standardized and the positions of stiffeners may be very different in each design. Thus, the utilization of robots in that field is very difficult. Although a lot of weldments have restricted shape and type of weld line, its size and position can be different and have various welding conditions such as welding velocity, angle, voltage and current, weaving pattern, etc should be changed according to the shape and type of weld line. This means that respective workpieces demand different robot programs. Therefore, the time consumed in programming can be longer than that in actual welding task. In addition to this problem, the automated welding system in fig. 1 needs three different programs. The system consists of a gantry transporter and two robots. And, each has independent controller. In that case, a field operators may have difficulty in programming due to their coupled motion.

Off-line programming tools can provide the cue for that problem and many tools have been developed[1][2][3]. However conventional off-line programming procedure has proven ineffective due to time-consuming teaching process. Well-known off-line programming tools like IGRIP(Deneb Robotics, Inc.) and ROBCAD(Technomatic, Inc.) are for general purpose. If a user programs welding task using these tools, whenever workpiece changes, he should redo shape modeling of workpiece through CAD tool and re-teach the all points on the path of robot. Their user interfaces are too difficult for field labors to use.

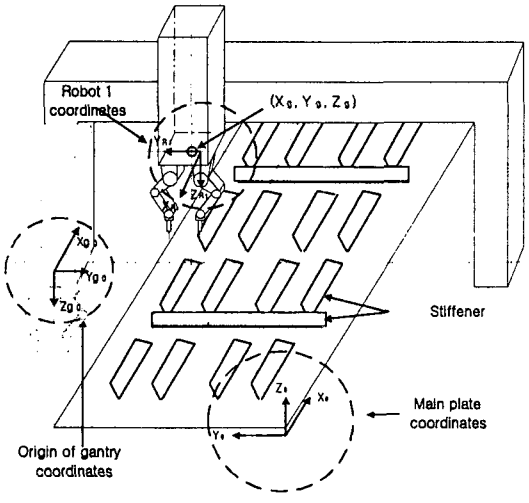

Fig. 1 Configuration of welding system