

A Repair Robot System for Automated Bridge Maintenance

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Summary

Manual crack repairing operations under bridge decks are time-consuming and hazardous. Replacing the manual operations with an automated or tele-operated robot system is therefore of great interest for improved safety, quality, and productivity. This paper presents a prototype repair robot system which has been developed for automated bridge maintenance. The repair robot system consists of a robot platform mounted on the tip of the working boom of the articulated crane robot developed by the Bridge Inspection Robot Development Interface (BIRDI) in Hanyang University at Ansan. The repair robot platform can position itself under bridge decks and perform crack repairing operations. The robot system can allow an operator to tele-operate the entire crack repairing procedures. The paper discusses the capabilities and limitations of the prototype repair robot and provides an outlook for the further development of the automated maintenance technologies by robots.

Keywords: Bridge; Maintenance; Robot; Automation; Cracks; Epoxy Injection.

1. Introduction

The number of bridges are increasing rapidly because of lot of constructions for vehicles across river, lake, channel, even sea, and high-level road in metropolitan area. Many of bridges are however not easy to repair because inspector or repair person with equipment is hard to approach the damaged area of bridge. At present, the repair person can reach the work area on manipulator of crane truck, and works on the narrow space and eyes and necks up for a while which work is hard and danger. Among many different types of bridges, concrete bridges are main focus, and the area to repair is selected to under side of bridge deck in this paper for the first trial of robot application.

Most of robots are using in industries for production. They work for welding, painting, assembling, and transporting. The number of, More than one million industrial robots are on the production line on the world. Some kind of robot manipulators have been engaged for dangerous work at hazardous area such as nuclear plant, underwater, fire place, space, mine, and even warfare. An application field of these outside service robots may be construction and maintenance of structure. A kind of robot for bridge inspection has built for improvement of productivity and safety. However bridge repair robot has not come yet. One prototype repair robot system is made, and testified for alternation of dangerous workers.

Manual work procedure is as follows. After decision of repair, the first procedure is that seals the most of crack-line except injection hole to prevent liquid epoxy flows out during injection. The second procedure is that the worker attaches injector on the hole, and injection begins when robot unlock the rubber band. The injection of liquid epoxy is supplied by injectors into the crack with low pressure and soaking action. On next day, the worker removes injectors finally. The repair robot works the same procedure as tele-operation.

Control technologies have developed, and tested to do the whole procedure for injection. One