Development of Advanced Robot System for Bridge Inspection and Monitoring

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Summary

Conventional bridge inspection involves the physical positioning of an inspector by the hydraulic telescoping boom of a “snooper truck” thereby providing visual access to bridge components. The process is time consuming, hazardous, and may be affected by lighting conditions. Therefore, it is of great interest that an automated and/or teleoperated inspection robot be developed to replace the manual inspection procedure. This paper describes the advanced bridge inspection robot system under development and other related activities currently undergoing at the Bridge Inspection Robot Development Interface. Its primary goal is to develop advanced robot systems for bridge inspection and monitoring for immediate field application and commercialization. This research project will contribute to advancement of infrastructure maintenance technology, enhancement of construction industry competitiveness, and promotion of national capacity for technology innovation.

Keywords: bridge, inspection, robot, automated, maintenance.

1. Introduction

After the collapse of the Seongsoo Bridge in 1994, Korean government established "Special Law for Safety Maintenance of Infrastructures." This law mandates that all important infrastructures, such as bridges, tunnels, dams, etc., must be inspected periodically. Conventional inspection methods involve the physical positioning of an inspector by the hydraulic telescoping boom of a “snooper truck” thereby providing visual access to otherwise unaccessible bridge components. The process is time consuming, hazardous, and may be affected by inspector and environmental conditions. Therefore, it is of great interest that an automated and/or teleoperated inspection robot be developed to replace the manual inspection procedure. The inspection robot system could also provide the only feasible means to access the place where structural engineers can not access.

There have been previous efforts using robots for infrastructure maintenance and monitoring. The Robotic Inspector (ROBIN) was developed at the Intelligent Robotics Lab at Vanderbilt University to inspect man-made structures [1]. The Robotic Bridge Management System (RBMS) was developed by the Construction Automation and Robotics Laboratory (CARL) at North Carolina State University. The system consists of a 4-degree-of-freedom robot mounted on the end of a truck-mounted peepercrane. Primary goals of RBMS include paint removal and painting of steel bridge beams and trusses [2]. Huston et al. [3] showed that a robot can be used to power and interrogate remotely placed addressable sensor modules (ASM’s) for structural inspection. Some early attempts up to 1980’s have been reviewed by Skibniewski [4].

The Bridge Inspection Robot Development Interface (BIRDI) is a research outfit with its home in the Department of Civil and Environmental System Engineering at Hanyang University at Ansan in Korea. BIRDI is funded by the Ministry of Construction and Transportation through a new R/D initiative on the Cutting-Edge Technology Fusion for Construction which started in 2005. Its primary goal is to develop advanced robot systems for bridge inspection and monitoring for immediate field application and commercialization as shown in Fig. 1. The research program consists of three major subject areas such as; 1) Integrated system for maintenance of bridges, 2)

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