

A study on shape determination method and operation experiment of inspection guide frame to avoid obstacles in tunnel

F. Inoue^{*}, S. Kwon^a, M. Terata^a, S. Yuzawa^a, S. Nakamura^b and Y. Yanagihara^b

^{*}Shonan Institute of Technology
Tsujiidou-Nishikaigan, Fujisawa, Kanagawa, 251-8511, Japan
inoue@mech.shonon-it.ac.jp

^a Shonan Institute of Technology

^b Institute of Technology, Tokyu Construction Co. Ltd

Abstract

Most of the infrastructure for civil engineering (tunnels, bridges, etc.) constructed mainly in urban areas during the period of high growth in 1970 - 1990 has reached the end of life and large-scale repair, renewal and reconstruction are required. Especially, due to the collapse of the tunnel which occurred several years ago in Japan, the inspection of the inner wall of the aged tunnel was requested. In order to advance the automatic inspection and maintenance of the inner wall of the tunnel, the "advanced maintenance and management robot development (SIP)" instructed by the Japanese government was implemented.

In this research, in order to improve the method of automatically inspecting the inner wall of an aged tunnel, a variable structure that can flexibly change the guide frame for examination according to the shape of an obstacle in the tunnel and its shape control method are reported. As shown in Fig. 1, the guide frame is an arch structure in which a variable geometry truss constituted by an extendable actuator and a hinge is linearly connected, and by controlling the length of each extendable member, it is possible to create the shape of several guide frame. The obstacles in the tunnel measured the shape and position using a three-dimensional laser sensor, the shape of the guide frame was changed so as to avoid obstacles, and moved through the tunnel. To determine the shape of the guide frame, we devised a method of connecting the multiple curves avoiding obstacles by spline interpolation to construct the overall shape. By applying this method, it was possible to easily determine the shape of the guide frame on the personal computer, and it was confirmed that it can be changed to a shape obstructing obstacles in the actual model experiment (Fig. 2).

In this paper, we report the basic structure of the guide frame, the shape determination method, the obstacle exploration method and the experimental result of the variable structure applying the real machine guide frame.

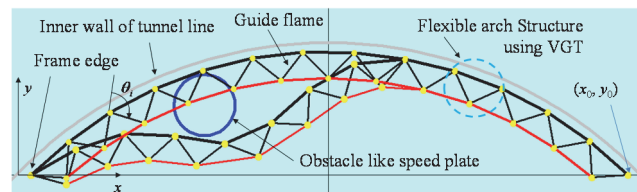


Fig. 1 Outline of guide flam and analysis of shape obstructing obstacles in the simulation

Reference

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Fig. 2 Shape obstructing obstacles in the actual model experiment in tunnel