



Development and Application of Fire Video Image Detection Technology in China's Road Tunnels

Wentao Dai ^a, Jixun Jiang ^b, Guofeng Ding ^c, Zhigang Liu ^{d*}

^a Shenzhen Municipal Design & Research Institute Co., Ltd., Shenzhen, China.

^b Xiamen Road Tunnel and Bridge Maintenance Center, Xiamen, China.

^c iNTVion Technology Inc., Beijing, China.

^d General Fire Technologies, Inc., Ottawa, ON, Canada.

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Abstract

A large number of highway tunnels, urban road tunnels and underwater tunnels have been constructed throughout China over the last two decades. With the rapid increase in vehicle traffic, the number of fire incidents in road tunnels have also substantially increased. This paper aims to review the development and application of fire video image detection (VID) technology and their impact on fire safety in China's road tunnels. The challenges of fire safety in China's road tunnels are analyzed. The capabilities and limitations of fire detection technologies currently used in China's road tunnels are discussed. The research and development of fire VID technology in road tunnels, including various detection algorithms, evolution of VID systems and evaluation of their performances in various tunnel tests are reviewed. Some cases involving VID applications in China's road tunnels are reported. The studies show that the fire VID systems have unique features in providing fire protection and their detection capability and reliability have been enhanced over the decades with the advance in detection algorithms, hardware and integration with other tunnel systems. They have become an important safety system in China's road tunnels.

Keywords: Road Tunnels; Fire Safety; Fire Detection; Video Image Detection Technology.

1. Introduction

In order to cope with the rapid growth of vehicle traffic and limited real estate, a large number of highway tunnels, urban road tunnels and underwater tunnels have been constructed throughout China over the last two decades. The statistics show that 15,181 road tunnels were constructed in China at the end of 2016, and the total length of the road tunnels have increased from 628 km in 2000 to 14,039.7 km in 2016 [1]. In addition, the complexity and length of the urban road tunnels constructed have also significantly increased. As of the end of 2016, there are 3,520 road tunnels stretching between 1 km to 3 km with a total length of 6045.5 km, and 815 tunnels longer than 3 km with a total length of 3,622.7 km [1]. Some examples of long tunnels in China include the Beiheng Tunnel in Shanghai (10 km long) and the Zizhi Tunnel being constructed in Hangzhou (13.9 km long). At the same period of the time, the traffic in China's tunnels has also significantly increased. The average daily traffic in some of road and underwater tunnels of cities, such as Shanghai, Nanjing and Zhongqi, has reached to 150,000 in 2017.

One of negative consequences with the increase in number of tunnels and traffic is that the fire incidents in China road tunnels, especially incidents involving loss of life, have substantially increased. For example, the Huishan Tunnel

* Corresponding author: zhigang.liu@rogers.com

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