



Fibre Optic Network Detection

SUMMARY

The aim of the fibre optic detection projects is to conduct studies into the feasibility of using fibre optic sensors to develop a traffic flow monitoring network.

INTRODUCTION

Fibre optic links offer a valuable component in the overall traffic network. Modern ITS networks require ever-increasing data rates and transmission capabilities to facilitate real-time communications between a wide variety of field devices and traffic control centres (TCCs). Single-mode optical fibre-based ITS infrastructures are displacing twisted pair copper and coaxial cables for both data and video transmission requirements in urban and rural jurisdictions worldwide.

An innovative trial currently being conducted by the Highways Agency is exploring the use of fibre optic technology for vehicle detection. The use of fibres over other systems (e.g. inductive loops) provides a more cost effective solution, capable of simultaneous functions such as traffic sensing and signal transmission via a common optical fibre. Two parallel projects are underway in order to ascertain the potential of fibre optic technology: FOLD (Fibre Optic Longitudinal Detection) and FOND (Fibre Optic Network Detection).

The FOLD Project

The aim of the FOLD project is to test longitudinal fibre optic technology as a potential sensor for monitoring traffic flow in order to support network operations, traffic management and traveller information systems.

The detection of vehicles will be investigated by installing a fibre longitudinally along a test

carriageway at QinetiQ's Winfrith Technology Centre in Dorset, England. This will provide continuous coverage along the length of the fibre. Furthermore, there is also potential for monitoring any pavement deformation and temperature.

The FOND Project

The aim of FOND is similar to that of the FOLD project however the principal difference is that fibres are positioned laterally across the carriageway at measured intervals. FOND is essentially an axle detector which has great potential for Weigh-in-Motion (WIM) sites.

This approach will demonstrate the ability of fibre optic detection to remotely interrogate a number of sensors via a roadside fibre by measuring headway, speed, axle count etc. Each sensor spans a single lane with a series of sensors across the carriageway forming a sensor site.

Benefits of Fibre Optic Detection

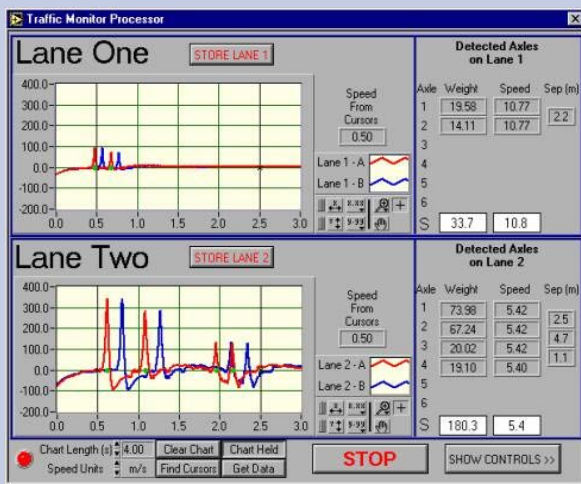
An extended development of a fibre optic network for monitoring has the following potential benefits:

- detection *and* signal transmission via a common optical fibre through
 - available bandwidth that allows multiplexing of many sensors (> 100) onto a single fibre; and
 - remote interrogation over large distances (> 50km).

Centrico BRIEFING NOTE

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- no electrical components used in sensing array, therefore providing:
 - high reliability; and
 - immunity to electromagnetic interference.
- good value detectors through
 - use of components developed through work for the Ministry Of Defence, and
 - multi-plexing many sensors.



TRIAL OBSERVATIONS

In 2005, field trials were carried out with the following results:

- sensors performed extremely well by detecting the passage of vehicles axis;
- axle separations, calculated directly from the speed, were very accurately measured (to within 1.4 %);
- Weigh-in-Motion capability clearly demonstrated; and
- further work is needed on the processing of the data to ensure continuous 'real-time' capture and analysis of axles.

NEXT STEPS

The Highways Agency now prepares to trial the FOND fibre optic technology on a live carriageway. In addition there is also the plan to install a 300 m length of fibre at the Winfrith Technology Centre and measure the capability of FOLD. In addition future plans involve:

- develop networked fibre optic sensors capable of measuring traffic flow for ATM as this system requires accurate and reliable measurements of traffic flow – a network of sensors, measuring traffic flow at regular intervals and feeding data back to a central processing point;
- assess the technology for its Weigh-in-Motion capabilities;
- design an interrogation system capable of multiplexing many sensors (> 100) together and interrogating those sensors over a large distance (> 50km); and
- evaluate the sensor and interrogation systems by performing a number of trials in a live carriageway conditions.

Other possible work on the system may include:

- add temperature and static strain during the measurements;
- carry out a road dynamics study; and
- perform a cable deployment study.

Fibre optical detection is an ideal candidate for application on the trunk road network, where a high-density of sensors and measurements are required.

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