Intelligence Infrastructure Futures

Artificial intelligence in transport

Information will be at the heart of any intelligent infrastructure system. The sheer amount of data and complex nature of the information processing required will make it essential to use such techniques as artificial intelligence.

Artificial intelligence (AI) attempts to emulate 'human' intelligence with computers. AI and the related concept of ambient intelligence (AmI) are well suited to handling the mass of increasingly complex and varied data needed to describe the operations of transport systems and how people use them.

Ambient intelligence is a vision in which we are surrounded by intelligent and intuitive interfaces, supported by computing and networking technology which is everywhere, embedded in everyday objects such as homes, vehicles and roads. AmI will enable greater user friendliness, more efficient services, user empowerment, and support for human interactions. For example, intelligent services could provide context specific information to travellers, advising on the best travel choices at the time of the journey.

Efficient use of capacity

There is considerable scope for AI to contribute to the development of new, intelligent modes of operation for the existing infrastructure to deal with capacity problems, poor safety, unreliability, environmental pollution and inefficiency.

AI is already deployed in many areas of transport in areas where learning algorithms are appropriate, for example in controlling traffic at intersections on arterial roads, travel-time predictions and fuel-injection systems. AI techniques also play a role in dynamic traffic management, using traffic lights, 'smart' barriers and variable message signs to advise drivers and allocate traffic priorities in time and space.

Traffic management models

AI techniques are increasingly a part of the intelligent traffic management models that analyse the behaviour and evolution of traffic. These systems do not replace expert human controllers but act as intelligent assistants that co-operate in the task of defining and applying traffic control decisions.

Short-term traffic prediction is important in providing real-time traveller information and route guidance. The latest integrated systems use congestion information to guide routing, both in advance and during a journey.

While traveller information systems have reached a high technical standard, we know little about how road users react to information. We need to develop systems that consider the behaviour of drivers. We also need to know how transport information services could influence their travel behaviour and guide their choice of transport mode.

Smartcard ticketing and automated fare collection is already in use in many countries for public transport. Systems such as London's successful Oyster card provide a passenger-friendly basis for electronic payment that eliminates cash handling and fraud. The memory and processing capabilities available on smartcard microchips allow development of flexible and innovative products for paying fares and other transport related charges. The techniques of AI are already widely employed in smart-card technology, for example, to combat fraud.

Automated vehicle control

Technology will change the driving experience for millions of motorists. Soon we will all have an impressive array of in-car high-tech gadgets to make driving a lot more fun – and in theory safer. In the longer term, artificial control systems, with control algorithms tuned over millions of hours of simulated and real driving, will have the advantage over humans. Eventually we may come to prefer automated rather than human control. Such systems will inevitably face acceptability issues. But these might be less severe if they bring added benefits, such as the ability to maintain the mobility, and ability to drive, of an ageing population.

AI systems have to be reliable or they will be perceived as poor substitutes for human judgement. The developers of AI must consider what happens when things go wrong, designing in self-checking and redundancy. When the intelligence fails, for whatever reason, control must transfer gracefully and, if possible, seamlessly, to the best available alternative, which could be a less-sophisticated local controller or a human operator.

Designers must also anticipate the possibility of hacking, sabotage, vandalism and criminal misuse, and other "worst case scenarios", including accidental or wilful non-compliance with operating procedures. Non-technical challenges involve issues of liability, costs and perceptions.

This Research Brief is based on the Research Review written by Dr John C. Miles and Mrs A. Janet Walker of Ankerbold International Ltd for the Foresight Project on Intelligent Infrastructure Systems. Series editors Professors Phil Blythe, Glenn Lyons, Will Stewart and John Urry. Editor Michael Kenward.

The full version of this review is at www.foresight.gov.uk