



A clever companion in the pipeline

A small silver robot equipped with six wheels, laser and sonar scanners and an umbilical cord attached to an artificial brain has been inching its way through Melbourne's sewers. Disguised as Dr Who's faithful friend, K9, the device has inspected more than four kilometres of the city's underground pipes, assessing structural defects with unerring accuracy.

The robot, code-named PIRAT (Pipe Inspection Real-time Assessment Technique), evolved from a joint project between Melbourne Water and the CSIRO divisions of Building, Construction and Engineering and Manufacturing Technology. Melbourne Water sought CSIRO's help in 1991, because it needed dependable information about the condition of the city's 18 000 km sewer network, sections of which are more than a century old.

Conventional inspection methods, such as the use of closed circuit television, were considered unreliable, largely because they depend on video images of variable quality to assess the severity of pipe defects. The video provides useful information on major defects, but lacks the objectivity to track pipe deterioration, which signals the need for preventative maintenance.

In contrast, PIRAT provides a quantitative assessment of sewer condition based on detailed measurements of the sewer's internal geometry. An in-pipe vehicle uses a laser scanner and other sensors for drained sewers and a sonar scanner for flooded sewer. The high-volume measurements are transmitted to a mobile control room which houses data processing and control equipment. (The measuring system was developed by the Division of Manufacturing Technology.) A closed circuit TV camera is carried for in-pipe navigation and to produce a video record of the inspection.

The measurement data are then analysed (using artificial intelligence software developed by the Division of Building, Construction and Engineering) to detect and classify defects and to rate their severity. Sewer engineers have ready access the geometry data for defective regions to further investigate repair options. As well as being more reliable and objective, PIRAT enables pipe condition to be compared accurately over time, improving the tracking of sewer deterioration.

Left and above: PIRAT gets down to work in Melbourne's sewers.

Although PIRAT is still under development, a number of overseas water authorities have expressed keen interest in its capabilities. Cities in developed countries such as Australia have approximately 5000 kilometres of sewer per million of population. Reliable inspection of underground sewers is critical to informed asset management and to prevent collapses which result in environmental damage and costly emergency repair. Damage is becoming more common as networks age and effluents become more hostile.

PIRAT project manager from Melbourne Water, Gary Campbell, says the cost of maintaining sewers is high and escalating. 'The ability to assess deterioration and to predict the impending collapse of a system has financial and environmental ramifications,' Campbell says. 'Damage to adjacent non-sewer assets can pollute the environment with sewage overflow and seepage to ground water supplies.'

'PIRAT has already helped Melbourne Water to more reliably assess the condition of a number of 600 millimetre concrete, clay and brick sewers, and the system will be adapted to other pipe materials and sizes in future.'

Organisations interested in seeking opportunities for applications of PIRAT should contact Dr Jacek Gibert, CSIRO Division of Building, Construction and Engineering, PO Box 56, Highett Vic. 3190, (03) 9252 6000, fax (03) 9252 6241, or Dr Kevin Rogers, CSIRO Division of Manufacturing Technology, Locked Bag No 9, Preston Vic. 3072 (03) 9662 7700, fax (03) 9662 7851.

