

Development of an inspection robot for gas distribution mains: a Mars-mission underground.

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abstract

In the Netherlands, the majority of the low-pressure gas distribution network (100.000 km) is currently only inspected above ground by 'sniffing' methods. For the high-pressure transport/distribution mains passive data loggers or pipe inspection gauges (PIGs) can be used for internal inspection. These systems have however no autonomous functionality and lack systems for navigation. The low-pressure net is 'non-piggable' due to the small diameters present and large number of bends, T-joints and other obstacles. However, to ensure safe distribution, the entire net has to be checked for leaks at least every 5 years.

The 'non-piggable' low pressure is mainly situated in the urban area and it has the highest risks for public health and safety. Moreover, since the replacement of pipelines in an urban area is very expensive, it is important to have accurate data on the state of the pipes and precise information on the locations of leaks and damaged sections.

The PIRATE project is aimed to design an energy efficient robot system, capable of autonomous navigation in low-pressure gas distribution network. Furthermore this project aims to develop innovative network sensor systems and sensing methodologies, which can be integrated in the robotic device for data acquisition on the gas distribution network. This system will enhance, and possibly replace the current practice of leak survey and improve the assessment of the quality of the mains, being able to investigate the mains very closely from inside.

This project has started with the design and the development of a single robot structure for navigation through small diameter, low-pressure gas distribution mains. The system has to be able to move through pipes of various diameters and through a number of complex obstacles, like bends, T-joints and elbows.

A prototype of the robot structure is currently being evaluated. The prototype is able to move through pipes of various diameters, and sharp corners can be taken (semi) autonomously. An optical sensor for both qualitative and quantitative assessment of the pipes has been developed.

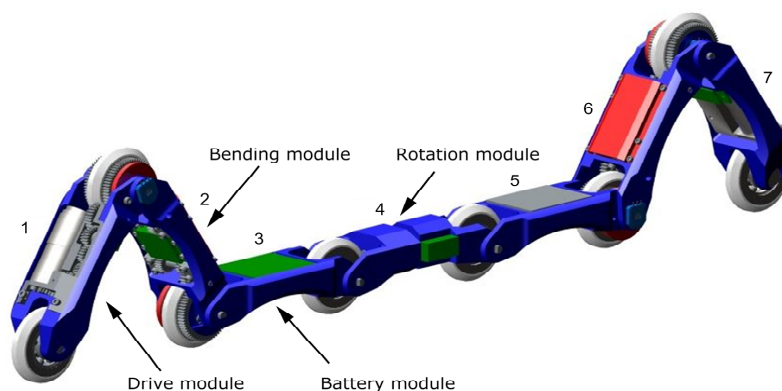


figure 1: schematic overview of the PIRATE robot design

Because of the harsh conditions (temperature, gas, dust), the complex network structure and the lack of communication (no long-range transmission underground) and hence the necessary autonomy for the robot, this project can be compared to a Mars-mission underground.