



1 MIMROex during field testing on an offshore platform

## MIMROex

### MOBILE MAINTENANCE AND INSPECTION ROBOT FOR PROCESS PLANTS

#### Starting Point

Inspection and maintenance tasks on offshore platforms as well as in chemical and petrochemical production facilities offer great potential for automation. However, due to the high complexity of installation as well as the requirement of additional maintenance this monotonous, sometimes dangerous work can only occasionally be carried out using conventional decentralized automation solutions. The use of a mobile inspection robot allows these problems to be overcome as well as to achieve lower operating costs and improved occupational health and safety. Especially the following maintenance and inspection tasks offer high potential for mobile robot operation:

- Monitoring of liquid levels and readings of gauges
- Acoustic inspection, e.g. of pumps
- Checking for leaks

- Taking of samples
- Maintenance of stationary fire and gas sensors.

#### Requirements

The operating environment of robots in the specified application areas is often characterized by extreme climatic conditions as well as by explosive and toxic atmospheres. Additional challenges include the need to navigate and move quickly over slippery steel floors, open gratings and sharp-edged steps; to manoeuvre in very narrow passages and to operate autonomously.

In order to guarantee reliable and beneficial service, the following requirements must be met by the hardware:

- The robot must be certifiable with respect to a standard such as ATEX or IE-CEx.
- The dimensions and undercarriage of the

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robot must be suitable for the above-mentioned operating conditions.

- The robot must be precisely aware of its position and environment, especially the presence of obstacles.
- The robot must be equipped with the application-specific actors, sensors and tools required for the autonomous or tele-operated execution of inspection and manipulation tasks.
- The robot must be capable of communicating with a central control PC.

### Robot Hardware

MIMROEx is the first prototype of an offshore inspection robot that meets these requirements. The robot has a circular base area with two differentially driven wheels which allow precise navigation even in confined spaces. A low centre of gravity guarantees the required stability. The robot can reach velocities up to 2 m/s with an operation time up to 12 hours.

The robot uses a laser scanner to perceive its environment and track its movements. The robot is equipped with a six-axis lightweight arm which carries a camera for performing visual inspections. Various application-specific sensors, such as a stereo microphone as well as gas and fire sensors, are mounted on the robot platform. Through the use of wireless LAN and Bluetooth, the robot is capable of wireless communication with the central control PC and with a mobile operator control device. Thanks to its innovative hybrid explosion protection concept, MIMROEx is certifiable in accordance with the IEC 60079 explosion protection standard.

### Automatic Data Recording

One of the most important functions of MIMROEx is its ability for safe navigation in offshore environments. This enables the robot to autonomously record sensor data at key locations or continuously monitor sensor data along a predetermined path.

The robot is taught inspection tasks on location using a manual operator control device, such as an explosion-proof PDA. Having taught the robot its new inspection tasks, the operator is then free to remain in the central control room while the robot autonomously executes the inspection tasks. A database in the central control PC is used to store the recorded sensor data for display and evaluation.

### Semi-Autonomous Operation

In addition to the configuration and scheduling of inspection tasks as well as the interpretation of the recorded data, the central control PC enables the user to supervise all relevant sensor data in real time. In addition, it is possible to tele-operate the robot which at the same time assists the user by analyzing data of its environment sensors. The user drives the robot around the environment in tele-operated mode in order to get close to objects that need to be inspected or manipulated. Once an object has been detected by the robot through its sensors, the object will be highlighted on the graphical user interface. The user can then start the automatic operation where the robot autonomously

executes movements or grasping operations to solve tasks, e.g. positioning its camera in front of a gauge or turning a hand wheel.

### What we offer

On the basis of an analysis of your application-specific requirements, the robot will be configured and set up to meet your particular needs.

Fraunhofer IPA will support you throughout all phases of your project – from application planning through the design and configuration of a suitable inspection robot and its sensor components to realization and putting into service.

In order to guarantee smooth and efficient operation within your company, we can provide your staff with personalized training in how to use our robots.

- 2 *Programming of inspection tasks*
- 3 *Automatic recording of sensor data*
- 4 *Semi-autonomous manipulation*