JARVIS

AUTONOMOUS ROBOT OPERATIONS IN OFFSHORE ENERGY PRODUCTION FACILITIES

Funded by the European Union

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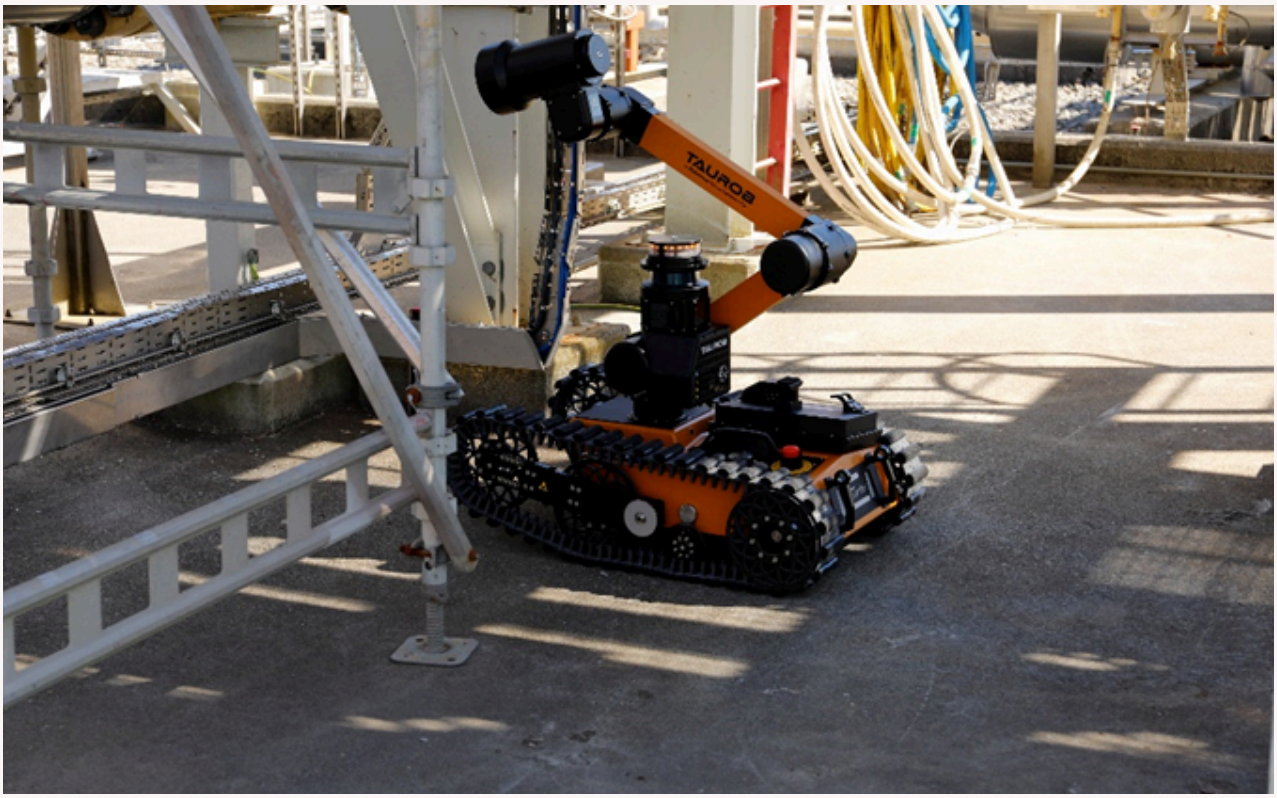
Offshore energy production facilities, like many other critical infrastructure sites, require regular inspection and maintenance (I&M) operations to ensure asset integrity and detect anomalies. These tasks include visual and audio inspections, as well as intervention activities such as turning valves or opening lids. While robots have the potential to significantly assist human operators in these operations, they often lack the ability to fully comprehend and autonomously plan their tasks.

To address this challenge, Equinor and SINTEF, as part of the EU-funded JARVIS Project, are developing automated planning solutions for robotic systems. This research is particularly relevant for mobile robot manipulators—robots equipped with an arm mounted on a mobile base that can navigate production facilities. These robots are fitted with advanced sensors, including cameras for navigation and inspection, while their robotic arms feature grippers for intervention tasks.



Picture: Equinor

TYPES OF ROBOTICS TASKS IN I&M

The JARVIS project categorises robotic tasks into two main types:

1. INSPECTION TASKS

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Inspection tasks involve gathering data without direct physical interaction with process equipment. These tasks can include capturing images or measuring sound levels in designated areas of a facility. While robotic operations in I&M involve various risks—such as potential collisions or obstructing walkways—the risk associated with inspections using ground-based robots is relatively low. This allows for high levels of autonomy, enabling robots to operate independently, even at night, without close human supervision.

2. INTERVENTION TASKS

Intervention tasks require robots to physically interact with facility equipment, such as pressing buttons or turning valves. These tasks pose higher operational risks, necessitating greater precision and safety measures to prevent damage to equipment or the robot itself. Given these risks, human oversight remains essential, making intervention tasks more suitable for daytime operations in collaboration with remote operators.

AUTOMATED PLANNING FOR ROBOTIC OPERATIONS

The JARVIS project focuses on two key levels of task automation, each requiring different degrees of human involvement:

COMPLEX SINGLE TASKS

For high-risk operations such as turning a valve, robots may require operator confirmation at critical decision points. For instance, before executing a valve turn, the robot can position its tool and request operator verification to ensure correct alignment. Additionally, automated planning tools can assist operators by mapping out high-level task steps, dynamically adapting the execution process, and suggesting alternative approaches in response to unforeseen challenges.

MISSION PLANNING FOR MULTIPLE TASKS

Routine operator rounds often involve a series of I&M tasks, such as operating switches, inspecting pumps, and monitoring facility equipment. With mission

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operators can define overarching objectives, and an automated system will generate an optimised execution plan. This process takes into account variables such as operator priorities, battery management, and real-time re-planning based on changing conditions.

ADVANCING AUTONOMOUS ROBOTICS IN OFFSHORE OPERATIONS

Through the JARVIS project, Equinor and SINTEF, in collaboration with project partners, are actively developing and demonstrating automated planning solutions for mobile robot manipulators—both in laboratory environments and real-world settings. By advancing robot autonomy and human-robot collaboration, this research aims to:

- Enhance safety by reducing human exposure to hazardous environments
- Improve operational efficiency in I&M activities
- Minimise costs by reducing the need for continuous human supervision

As automation technology evolves, robots will play an increasingly integral role in offshore energy production, ensuring safer, smarter, and more efficient operations.

Picture: Equinor

Any questions? Feel free to contact synne.fossoy@sintef.no

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