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Embodied Intelligent Vehicle-Arm Cooperative Inspection Robot for Complex Environments

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01 ABSTRACT

This work develops a vehicle-arm collaborative robot system integrating autonomous navigation, visual perception and flexible operations to address inspection challenges in complex scenes.

Research question

How to integrate navigation, vision and flexible operations for inspection-maintenance tasks in complex environments?

02 METHOD

The system is centered on mobile chassis, flexible robotic arm[1] and visual perception, forming a clos ed loop from path planning and environment recog nition to flexible operations at the end-effector.

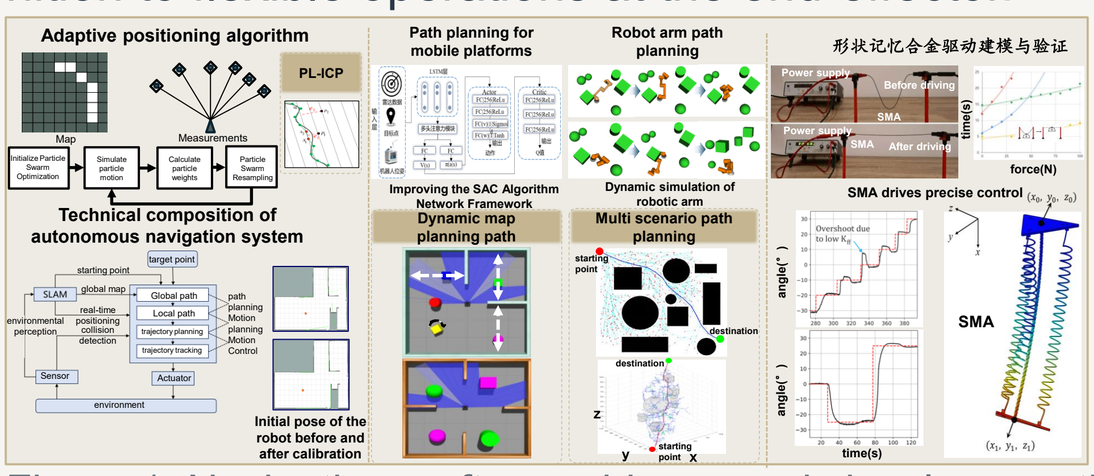


Figure 1. Navigation, software drivers, and visual perception

Implementation details

Autonomous navigation / Path planning and obstacl e avoidance / SMA drive / Extreme environment visu al enhancement

03 RESULTS

Key verifications are carried out for vehicle-arm c ollaborative perception-based operation-mainten ance and flexible manipulator operations.

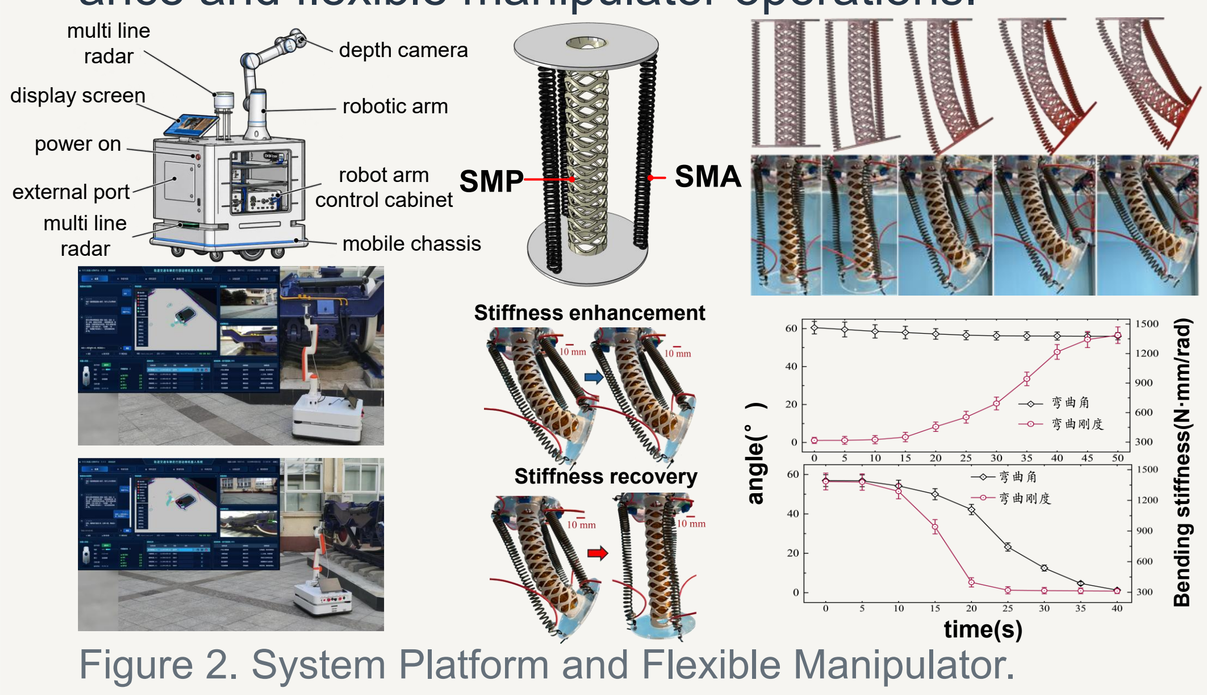


Figure 2. System Platform and Flexible Manipulator.

Table 1. Module verification results.

Module	Verification content	Result performance
Autonomous navigation	Mapping and path planning	Improved obstacle avoidance ability
Flexible operations	Controllable bending and pose locking	Adapt to confined spaces
Vehicle-arm collaboration	**Mobile chassis and robotic arm linkage**	**Adapt to various working conditions**

Key result

The system exhibits efficient, stable and reliable o perational capabilities in complex scenarios; throu gh visual perception and collaborative control, the robot can accomplish tasks including inspection & detection, target recognition, and flexible operatio ns.

04 DISCUSSION

High-risk inspection tasks are hard to achieve full coverage, and the vehicle-arm collaborative perception still requires further optimization.

05 CONCLUSIONS

This study develops an embodied intelligent vehicl e-arm collaborative robot system integrating auton omous navigation, visual perception, flexible oper ations and collaborative control.

CONTACT

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REFERENCES

[1] Chen, Qianyi; Wu, Ruochen; Schott, Dingena et al. / Programmable structure with shape memory materials for soft robotics. In: Smart Materials and Structures. 2026 ; Vol. 35, No. 1.