

## “Practical Applications of Inspection Robots to Enhance Petrochemicals Plants Reliability”

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### Abstract

Predictive maintenance is a critical issue for petrochemical business. Mechanical integrity failures in petrochemical plants lead to safety and environmental impact which affected business interruption and competitiveness. However, implementing predictive maintenance to achieve mechanical integrity and plant reliability is very exhaustive and consists of high risk tasks. For instance, in a petrochemical complex, there could be hundreds of equipment and thousands kilometers of pipeline. Many of those might expose to high risk areas, for example, confined space and work-at-height. Therefore, it is impossible to cover all the necessary predictive maintenance tasks with conventional, human based work.

SCG Chemicals realizes the opportunity of bringing robotic technologies to enhance our predictive maintenance. Thus, we established dedicated team to develop robots for enhancing predictive maintenance effectiveness and efficiency. We explore the gap with our subject matter experts to find our critical pain points. Then, we develop five robot platforms to cover most of inspection tasks for petrochemicals including 1) Pipe climbing platform 2) Steel surface climbing platform 3) Pipe internal crawling platform 4) Drone platform and 5) Underwater vehicle platform. With these platforms, NDT sensors can be integrated with the robots to perform the tasks.

One of our successful cases is the implementation of carburization inspection robot to coils in ethylene cracking furnace. Ethylene cracking furnace is critical equipment in olefin plants and carburization is a dominating failure mode of furnace coil. Conventional method uses handheld carburization probe to measure the carburization value manually while inspectors have to work on a scaffold in a confined space of furnace firebox for hours. Moreover, it is time consuming and the inspection coverage is only 20%. We develop carburization inspection robot from our pipe climbing platform and combined with our own-developed carburization sensors. After years of continual improvement on the robot, the robot works perfectly and could deliver the following outcomes: 1) Eliminating risk from work at height and also the scaffolding cost 2) Shortening inspection time for more than 7 times, which means plant downtime might also be shortened 3) Dramatic increase of inspection coverage to >80%, which is more than 5 times compared to manual inspection. The accurate, thorough inspection data is very crucial for further analysis including remaining coil lifetime assessment using stress analysis from FEA and CFD following Fitness for Services Method, which at the end of the day could save huge amount of maintenance cost to the business.

In conclusion, after years of using own-developed robotic inspection, we have realized that robotic inspection can be the next generation of NDT as it avoids risks to human while effectively collects more data for further in-depth analysis.