

Insect inspectors: NTU developing cyborg cockroaches to check utility pipes

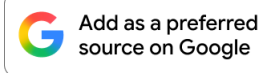
[Sign up now](#): Get ST's newsletters delivered to your inbox



A Madagascar hissing cockroach inspecting the underside of a pipe in a mock-up scenario at Nanyang Technological University on Feb 11.

ST PHOTO: BRIAN TEO

Poh Yijian



Summary ⓘ

- NTU researchers are developing cyborg cockroaches for utility pipeline inspection, using cameras and machine learning to detect defects like corrosion and leakage.
- The project, which began in early 2025, is testing cyborg cockroaches in a simulated Marina Coastal Expressway pipe environment, with plans for real-world deployment.
- Building on technology from a similar model used for the 2025 Myanmar earthquake search-and-rescue, these cyborg

cockroaches are able to access the tight spaces beneath utility pipes and carry out inspection work.

✦ AI generated

Published Mar 01, 2026, 01:36 PM

Updated Mar 01, 2026, 02:57 PM



SINGAPORE - Deep underground, a cockroach scurries through the dark and damp underside of a utility pipe.

The Madagascar hissing cockroach is on a mission to check for corrosion and leakage.

Developed by a team of researchers from Nanyang Technological University (NTU), these insects are part of a new pilot project aimed at revolutionising the maintenance of utility pipelines.

The project, which has been in development since early 2025, is currently being tested in a simulated environment modelled after pipes along the MCE.

Each cockroach is manually fitted with a small plastic “carriage” that houses an on-board processor and an electronic circuit board, which contains an upward-facing colour video camera, an LED lightbulb, and a communication module for location tracking and data transmission.



The Madagascar hissing cockroaches are fitted with a small plastic “carriage” that houses an on-board processor and an electronic circuit board. The insect tows the wheeled cart along the underside of utility pipelines to check for defects.

ST PHOTO: BRIAN TEO

On average, an adult Madagascar cockroach is 6cm long – 2cm longer than the local variety.

Electrodes attached to the insects’ antennae and rear deliver weak pulses that simulate the feeling of bumping into an obstacle, allowing researchers to seamlessly steer the cockroaches along a desired path.

The inspection process is automated and relies on a machine-learning algorithm to recognise specific types of pipe defects. When defects are detected, a human operator is alerted.

The goal is to eventually deploy these cockroaches into the real-world environment. But there are some obstacles to overcome first.

Professor Hirotaka Sato from NTU’s School of Mechanical and Aerospace Engineering, the lead researcher for the project, said: “Actual pipe environments may be darker and wetter, with possible water accumulation, compared with controlled testing conditions.”

The pilot projects follows the successful deployment of 10 cyborg cockroaches in [search-and-rescue efforts during the 2025 Myanmar earthquake](#).

That project was handled by Prof Sato's team in partnership with Singapore's Home Team Science and Technology Agency and engineering firm Klass Engineering and Solutions.

The equipment then – infrared cameras and sensors – was designed to be extremely compact, allowing the cockroaches to navigate through collapsed structures and confined spaces to search for survivors.

In contrast, Prof Sato said “infrastructure inspection takes place in more structured environments”, which are more generally defined and have predictable terrain.

“This allows us to trade some degree of compactness and agility for improved sensing capability and system stability,” he added.

The tow cart was thus designed, increasing load capacity and allowing for more stable imaging and sensing hardware.

Prof Sato said the new model reduces physical strain on the insect, which improves endurance and overall operational stability during infrastructure inspection.

The team is now developing both the rescue and inspection models simultaneously. The move into infrastructure inspection came about when they saw an opportunity to adapt their research for a real-world use case.

“Regular inspection helps detect issues early, so that repair or replacement works can be carried out before more serious damage or disruption occurs,” he noted.

Highlighting their small size, Prof Sato said cyborg insects are well suited to “access tight spaces and crevices where humans cannot easily operate, making them useful in diverse environments”.

More on this topic

[Cyborg roach ready for search and rescue efforts in 1 minute](#)

[S'pore's cyborg cockroaches helping with search-and-rescue efforts in Myanmar quake](#)

The team is currently in discussion with government agencies regarding the application of such technology in real-world infrastructure inspection.

Singapore has a 6,000km water pipeline network, which supplies potable water to around 1.7 million households and businesses daily.

Universities in Denmark, China and the United States have also been developing robots for pipeline inspection. One such project, led by a team at China's Guangxi University, successfully prototyped a soft, bionic inchworm robot that crawls through pipelines using magnetic force in 2025.

Though the cyborg cockroach is currently designed for utility pipelines, Prof Sato said the machine-learning algorithm involved can be adapted to look for other types of defects in other infrastructure, such as telecommunication and electrical cables.

Should this technology prove successful in real-world applications here, he is confident about the project's global scalability, stressing that the concept is particularly relevant for other countries grappling with ageing underground infrastructure.

He said: "Differences in pipe materials and layouts may influence how the system is adapted, but the core capability remains applicable."

See more on

NTU

Technology and research

Earthquakes