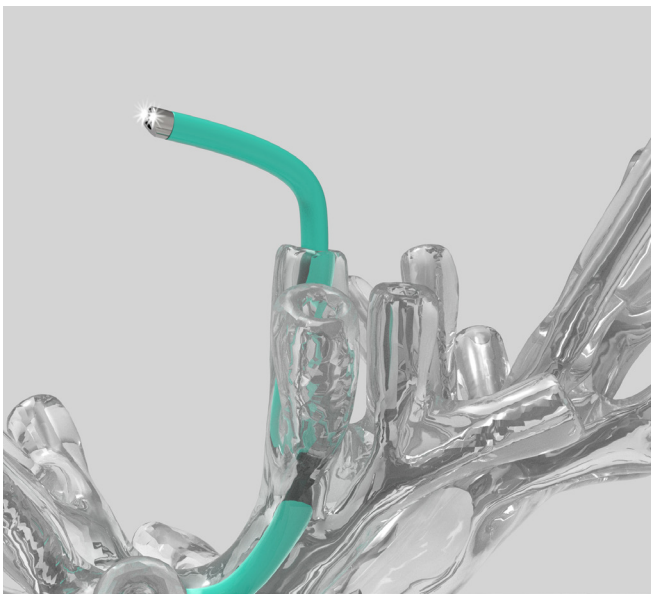
ADVANCED ROBOTICS FOR EARLY-STAGE LUNG CANCER DIAGNOSIS AND TREATMENT

A robotic tool has the flexibility and precision to help clinicians better DIAGNOSE AND TREAT LUNG CANCER at an early stage.

Lung cancer typically is diagnosed at a later stage than other malignancies, due to the lack of early warning indications. In 2020 it was China's most common cancer and the leading cause of cancer-associated mortality. LungHealth MedTech, a medical robotics company in Shanghai, has developed a robotic-assisted bronchoscopy platform that can address some of the current diagnostic challenges and treatment limitations.

Routine screening programmes and advancements in imaging technologies are improving the discovery of lung nodules. Once a nodule is detected, a bronchoscopy can be used to inspect the suspicious areas and take tissue samples. However, a bronchoscopy requires a high degree of skill gained through years of clinical training. Additionally, lung nodules are often located in peripheral regions of the lungs that are hard to reach with traditional bronchoscopy.

Human lungs are a complex, fractal network of airways. "Imagine the lung as a tree and early-identified lung nodules as its fruit that typically grows on the treetops, but not on the trunk," explains Jiajun Ma, the founder and chief executive of LungHealth MedTech. "The bronchoscope has to go through many branches to reach the target, which requires appropriate tools and accurate navigation."



▲ **The robot-assisted bronchoscopy system comprises a seven-axis manoeuvrable arm, a flexible articulated bronchoscope and an electromagnetic navigation subsystem.**

In conventional hand-held bronchoscopy, a skilled operator passes a long and relatively wide tube into the patient's airways. Once the lesion is found, the operator must press the controller with steady force and at a certain amount of angulation — a process that may result in slippage or displacement to adjacent airways. The deeper the bronchoscope goes, the more complex the branching, and the easier it is to 'get lost', resulting in poor diagnostic yield.

LungHealth's robotic-assisted bronchoscopy system, Unicorn™, is designed to overcome these limitations. It has a flexible robotic-articulated bronchoscope with precise motion control, free angle adjustment and high stability, and a smart navigation and positioning system for more accurate biopsy and treatment. The controller appears similar to one used for video games consoles, and operators can get started after just a few practice attempts.

"The tricky part is to balance flexibility and precision to get safe and reliable diagnoses," says Ma. "Physicians want the endoscope to be thin enough to access the narrow peripheral lung, yet wide enough for any operation; it also needs to pass smoothly through bending airways, while providing supporting force to avoid missing the target."

To tackle the challenge, scientists and engineers at LungHealth MedTech simulated and experimented with a variety of structural designs and materials. Precise motion is enabled through the closed-loop actuator, and Unicorn™'s robotic tool can be turned 360 degrees at its distal end, with a maximum bending angle of more than 200 degrees in any direction. This allows it to navigate into a bronchial tree beyond its tenth segment.

The team is now conducting a clinical trial of the robotic system. It is also further refining the robotic system for even better diagnosis and new surgical treatment uses. Ma envisions that medical robotics will be a pioneer in the intelligent digital transformation of precision medicine. "Through integrating advanced materials, real-time imaging, an AI algorithm and clinical big data, the robotics will help reduce manual error and support clinical decision making." ■

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