AI Hunts Down Cancer 'Shape Shifting' Cells

Dialogue

By LONG Yun & BI Weizi

In the fight against cancer, the primary tumor is rarely the deadliest threat. Rather, it is metastasis — the spreading of cancer cells. This lethal process begins with "escapers," or Circulating Tumor Cells (CTCs), that break away from the original tumor.

While capturing these "escapers" has long been a technical nightmare, a new frontier has been breached. Professor Learn-Han Lee of the University of Nottingham Ningbo, China, a scientist and director of the Asia Pacific Microbiome and Biomedical Research Network (AMBeR), is leading this charge. His team's recent work, which systematically reviews strategies using single-cell ribonucleic acid (RNA) sequencing (scRNA-seq), offers a blueprint for intercepting these cells before they spread.

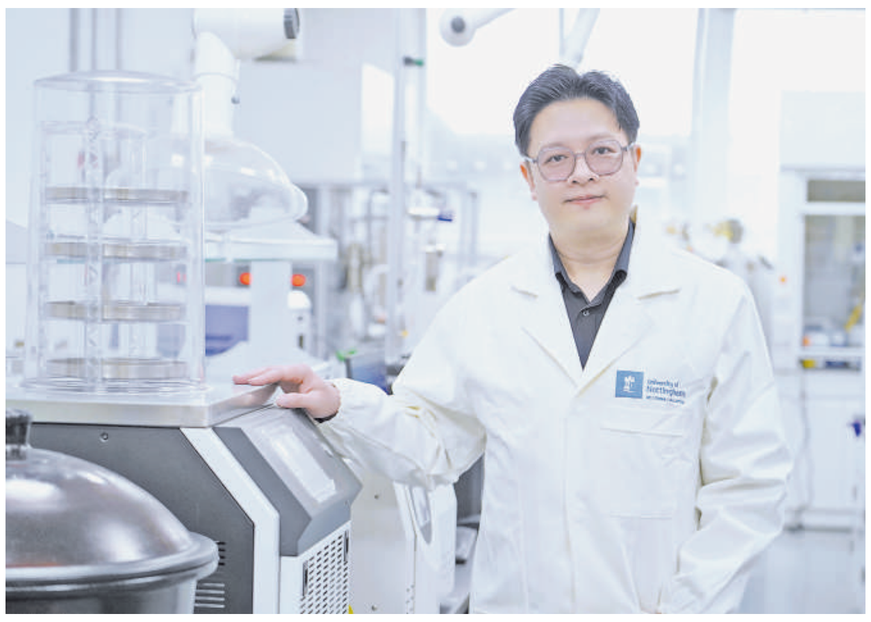
By combining molecular biology with AI, Lee and his team are turning the tide in the battle against metastasis.

The shape-shifting disguise

The first challenge in catching a CTC is recognizing it. These cells are masters of deception, often hiding in plain sight among billions of normal blood cells. When asked how these cells manage to evade detection, Lee described them as biological "shape-shifters." He acknowledged that the cells employ a dual strategy of disguise and dormancy.

"The CTCs use a process called Epithelial- Mesenchymal Transition (EMT). Essentially, they shed their 'normal' cellular ID tags, like the EpCAM marker, which many of our standard detection tools look for," he said.

However, their survival strategy goes beyond molecular camouflage. Lee noted that these cells are socially complex. Instead of traveling alone, they form clusters or even hide within the body's own immune cells, such as neutrophils and platelets, using them as shields. Furthermore, they possess the patience to wait. Lee explained that many CTCs will not immediately metastasize. Instead, they can remain dormant for long periods, quietly surviving until environmental signals, often from the tumor microenvironment, trigger them to "wake up" and seed metastases.



Professor Learn-Han Lee. (COURTESY PHOTO)

AI as the molecular detective

To analyze the massive datasets generated by single- cell sequencing, Lee's team has turned to AI. In this context, AI is not merely a calculator but also a detective. Lee asserted that, "AI has absolutely become a detective, and a very sharp one." While scRNA-seq generates massive, complex datasets that are too large for manual analysis, AI, specifically machine learning, goes beyond just crunching numbers. From his perspective, researchers have successfully used AI to identify CTCs among millions of blood cells. Furthermore, using an algorithm called CTC-Tracer, they can even predict which specific lesion or organ a CTC originated from. Lee explained that while a CT scan typically reveals a tumor only after it has grown, AI possesses the capability to analyze the transcriptomic profile of a single CTC to indicate that the cell carries a high risk of metastasizing to the bone or brain, thereby providing a molecular warning system.

This precision is vital because not all cancer cells are created equal. Lee emphasized that treating them as a monolith is a fatal error in precision medicine. He likened treating all CTCs as one group to assuming every person in a crowd has the same intention. If doctors treat all cancer cells with the same therapy, they might kill the majority but leave the dangerous, therapy-resistant subtypes behind to proliferate.

Lee pointed out that his recent article provides concrete examples, such as in non- small cell lung cancer, where one discovered CTC cluster was highly proliferative while another was mesenchymal (cells that develop into connective tissue, blood vessels, and lymphatic tissue) with immune evasion properties. He noted that if researchers only examine the average, they would miss that immune evasion signature entirely.

By analyzing individual cells, researchers can spot critical differences that would be missed in bulk samples. Lee highlighted that they would also miss hybrid cells — fusions of tumor and immune cells — which are implicated in metastasis and resistance.

Bridging the gap

Beyond the lab, Lee focused on the practical application of these technologies. He identified the biggest barrier to global health not as the cost of technology, but the lack of standardized workflows. He noted that while one could buy a sequencer, without a validated, step- by- step guide to handle rare CTCs from blood draw to data interpretation, the technology sits idle.

Lee observed that while the cost was decreasing and open- source bioinformatics tools were becoming available, the actual bottleneck lay in training and infrastructure to ensure consistency. He argued for the necessity of moving away from "bespoke" science in wealthy nations to create robust, simplified kits that could function effectively in labs with fewer resources.

To solve this, Lee advocated for international collaboration to create robust, simplified kits that can be used in labs with fewer resources. He stressed the need to tackle the "last mile" problem: ensuring that the data generated leads to an actionable clinical decision. Without that, he asserted, even the best scRNA- seq technology cannot fulfill its role.

University of Nottingham Ningbo also contributed to this article.

Token Surge Drives Chinese AI Models' Rise

Science Outreach

By Staff Reporters

Chinese AI models are leading the pack after recording a weekly token usage of 7.359 trillion from March 16 to 22, a 56.9 percent increase from the previous week. That's in stark contrast to U.S. models, which saw a usage of 3.536 trillion tokens during the same period, with a modest weekly growth of 7.35 percent, according to the latest data from OpenRouter, the world's largest AI model API aggregation platform.

The data highlights a significant shift in the global AI landscape, with Chinese models demonstrating strong adoption and application at scale.

What is a token?

To understand the significance of this metric, an understanding of "token" is essential.

"Tokens are the basic units of text processing for large language models, which can be understood as 'word chunks' from an AI's perspective," said Ma Zhiheng, an assistant professor at the School of Computing Microelectronics, Shenzhen Institute of Advanced Technology.

Before text is fed into a model, it is broken down into tokens and converted into vectors. For example, a single Chinese character typically corresponds to one or two tokens. Every user query and the AI's subsequent response consume a certain number of these tokens.

Ou Weijie, head of the Yashan LAB at the Shenzhen Academy of Computing Sciences, provided an analogy: "If 'computing power' is seen as 'electricity,' then tokens are the 'kilowatt-hours' consumed. They are a core indicator for measuring AI activity and processing scale."

Why is China's token usage so high?

The surge in token usage is driven by a combination of factors, primarily cost- effectiveness and widespread application.

Data from OpenRouter shows that the top four models by weekly usage are all from China, namely Xiaomi's MiMo V2 Pro, StepFun's Step 3.5 Flash (free), MiniMax's M2.5, and DeepSeek's V3.2.

"In terms of pricing, domestic models represented by DeepSeek and MiniMax have significantly reduced API usage costs, stimulating demand from developers and enterprises," Ma said. Chinese companies have taken a leading role in the open-source model space, narrowing the technological gap with top-tier global closed-source models to about three months, while offering them at a much lower price, he added.

Luo Jieping, executive director and chairman of the board of Yuexiu Port Holdings Co., Ltd., pointed to the vast user base in China as another key driver. "Chinese developers have contributed a substantial amount of token consumption. Applications like WeChat, DingTalk, and Feishu can reach billions of users. These users can access AI capabilities with a simple click, which undoubtedly generates massive demand for model calls."

This accessibility makes AI a practical tool for diverse users. As cost optimization continues in areas like inference and response speed, a large number of small and medium- sized enterprises and developers are integrating AI into their business processes, triggering a long- tail effect in token consumption.

Tech+Culture

How Ancient Chinese Metallurgy Forged Civilization

By Staff Reporters

The development of ancient Chinese metallurgy stands as an important achievement in human civilization. It was a systematic process marked by a high degree of independent innovation, deeply intertwined with the social structure and intellectual culture of its time.

Although the earliest copper and iron smelting techniques did not originate in the lands that would become China, Chinese artisans eventually surpassed others through a series of original technological breakthroughs. From the piece- mold casting of the Bronze Age to the invention of pig iron smelting in the Iron Age, these innovations boosted productivity and provided the essential material foundation and technical support for the formation of early Chinese states and the construction of the ritual system.

Piece-mold casting

The rise of China's Bronze Age marked the maturation of an independent and highly sophisticated technological system. Unlike early copper artisans in West Asia and the Mediterranean region, who primarily used lost- wax casting or forging, craftsmen in ancient China, beginning in the period of Erlitou culture (a Bronze Age culture in the Yellow River valley from approximately 1900 BCE to 1500 BCE), pioneered and developed the technique of piece- mold casting. This foundational method set the course for subsequent bronze production and even metalworking in China.

In essence, piece-mold casting uses multiple pre- made inner and outer molds to form a cavity into which molten metal is poured in a single operation. This process demanded a high level of systematic planning and precise process control.

The Houmuwu Ding from the late Shang Dynasty (1600 BCE- 1046 BCE), a massive rectangular sacrificial vessel famed as the heaviest known ancient bronze artifact in the world, is a prime example.

Its casting required nearly 100 individual ceramic molds and integrated various technical elements, including composite clay molds, sectional casting, precise mold assembly, large-scale smelting and pouring, and scientific alloy ratios. These technical steps were tightly interlinked, forming a complex and meticulous engineering system.

Precisely because piece- mold casting enabled the mass production of bronze vessels with complex shapes, standardized forms, and intricate decorative patterns, bronze objects were able to transcend their purely practical functions to become the ultimate symbols of the ritual and musical systems. The innovation in metallurgical technology thus became the crucial material medium through which "ritual civilization" was established and expressed.

Achieving breakthroughs

Another landmark contribution of ancient Chinese metallurgy to human civilization was the invention and large-scale application of pig iron smelting. For a long period, the rest of the world primarily relied on the bloomery process, which reduced iron ore in a solid state to produce a spongy mass of wrought iron.

This method was inefficient and did not allow direct casting. In contrast, China had mastered the liquid smelting of pig iron through a series of technological innovations by the late Spring and Autumn Period (770 BCE-476 BCE) at the latest.

The key to this breakthrough was the advancement of bellows technology and the iron- smelting furnace. By raising the height of the shaft furnace, intensifying the air blast, and using fluxes, craftsmen were able to raise the internal temperature sufficiently to melt the iron ore, producing liquid pig iron that could be cast directly into shape.

The production efficiency of liquid pig iron smelting far surpassed that of the bloomery process. It also allowed for the casting of complex implements, including durable iron molds, which enabled the self-reinforcing crafting of production tools.

Although pig iron was highly hard, its brittleness limited the range of its direct applications. To resolve this problem, Chinese craftsmen from the Warring States Period (475 BCE- 221 BCE) to the Han Dynasty (202 BCE- 220 CE) developed a comprehensive set of subsequent processing and reprocessing techniques, forming a complete iron and steel technological system.

Annealing involved subjecting cast iron objects to prolonged heat treatment to "soften" them, producing malleable cast iron with significantly improved strength and toughness. Puddling involved heating pig iron to a semi-molten state and stirring it in the air to decarburize it into steel or wrought iron.

The co- fusion process took advantage of the high carbon content of pig iron and the low carbon content of wrought iron by smelting them together, allowing the carbon from the pig iron to evenly diffuse into the wrought iron, thereby efficiently obtaining high- quality steel.

These technological innovations gave rise to a unique and distinct system of iron and steel technology in ancient China, enabling the country to lead the world in both the quantity and quality of iron and steel production for a considerable period. Iron and steel were thus widely applied in the manufacture of agricultural tools, implements, and weapons, greatly boosting agricultural productivity and advancing military technology, providing a solid material foundation for the economic development of ancient Chinese society.

This is edited and translated from the article written by Qian Wei, dean and professor of the Institute for Cultural Heritage and History of Science & Technology, University of Science and Technology Beijing.

The photo shows the Houmuwu Ding (also known as Simuwu Ding). The bronze cauldron was cast using nearly 100 clay piece molds and integrating composite mold techniques, separate casting, precision mold joining, large-scale smelting and other technologies. (PHOTO: VCG)

How Water Clocks Flowed with Time

Traditional Eastern Wisdom

By BI Weizi

The water clock, also known as clepsydra (water thief in ancient Greek), is a device that measures time based on the controlled flow of liquid into or out of a container, with time indicated by the volume of liquid. It is one of the earliest timekeeping devices, believed to be in use around 1500 BCE.

The basic principle behind these clocks is Torricelli's law, a theorem in fluid dynamics which relates the velocity of fluid exiting a hole to the height of the fluid above that opening.

There are two main types of water clocks: inflow and outflow. In an outflow water clock, a vessel is filled with water and the water is gradually and consistently released from the vessel. This container features lines that measure the passage of time. As the water drains, an observer can use the lines to determine how much time has elapsed.

An inflow water clock operates in a similar way, but instead of draining from the container, it is filled by the water. As the vessel fills, the observer can see where the water level aligns with the lines to determine how much time has elapsed.

In ancient China and across East Asia, water clocks were crucial tools in the fields of astronomy and astrology. The earliest recorded mention of the water clock dates back to the 6th century BC in China. From around 200 BC onwards, the outflow clepsydra was widely replaced throughout China by the inflow clock, featuring a float-supported indicator rod.

Huan Tan (40 BC-AD 30), a Han Dynasty philosopher and politician, noted the necessity of comparing clepsydrae to sundials due to the impact of temperature and humidity on their precision. This indicates that the influence of evaporation and temperature on the rate of water flow was already recognized during this period.

As the water in the clocks was prone to freezing, fire torches were used to keep the water in a liquid state, a problem that was solved in 976 by the Chinese astronomer and engineer Zhang Sixun. His invention utilized mercury instead of water. Mercury remains in a liquid state at room temperature and solidifies at −38.83 °C, which is lower than the typical air temperature found outside polar regions.

Independently, the Chinese developed their own sophisticated water clocks featuring gears, escapement systems and water wheels, passing their innovations on to Korea and Japan.