



BEYOND THE LEARNING CURVE

Computer scientists at **WUHAN UNIVERSITY** are making breakthroughs in AI theories and methods, leading to innovations in healthcare, unmanned systems, and more.

Intelligent diagnosis systems for health services, video retrieval technology for security monitoring, intelligent navigation for unmanned systems are all applications for artificial intelligence (AI) technologies developed at the School of Computer Science, Wuhan University (WHU).

A pioneer in AI research, WHU is among the first in China to offer an immersive programme in AI, including machine learning, programming, and evolutionary computation. With broad strengths in computer vision, graphics, image and natural language processing, data science and engineering, media computing and analysis, as well as intelligent software, WHU's School of Computer Science is a leader in China. The school houses research institutes and centres on data science, big data engineering, multimedia software engineering, dedicated to advancing research on AI-related theories and technologies.

Breakthroughs in AI theories and methods

In machine learning, minimizing data noise is essential for enhancing algorithms and supporting the machine's learning process. Based on the paradigm of learning using privileged information, that is, feeding additional knowledge, computer scientists at WHU proposed a novel algorithm to improve the robustness of the model against noisy sample data. They introduced a regularizing function that integrates both normal sample data and privileged information to increase the tolerance of the learned model. Experiments on real data demonstrate the effectiveness of the algorithm, which was presented at the 2018 International Joint Conference on Artificial Intelligence, and selected as a distinguished paper.

To manage huge data with complex structure and semantics, a trend for AI, WHU computer scientists created

an easy tool, called the object deputy model, which resolves data inconsistency and conflicts during data integration. Based on this data model published in leading journals, they developed an object deputy database management system, TOTEM. With advanced functions, including object views, dynamic classification, and cross-class query, TOTEM can construct flexible knowledge graphs and perform high-efficiency relational computation.

The WHU intelligent software and services team, with a dedicated research institute in the area, is focused on novel methodologies, techniques, and tools for reinterpreting core activities of software engineering and service computing, ranging from design and coding, to debugging and maintenance. Their research results have led to series of standards published by the International Organization for Standardization (ISO) for software inter-operability

services, which are widely applied in China's industrial automation. Their automatic software construction and quality assurance methods have won awards from the Association for Computing Machinery (ACM), such as the Distinguished Paper Award of the Special Interest Group on Software Engineering (2018).

Use of AI in healthcare

An important application of AI technologies is in healthcare, ranging from medical imaging to diagnosis and treatment. The medical AI team at WHU developed a framework for identifying autism spectrum disorder (ASD). Early diagnosis is crucial for managing the condition, yet is difficult, due to a lack of biomarkers. The WHU team focused on a deep neural network whose architecture is adjustable by an enforcement learning component. Their framework directly makes decisions based on analysis of brain signals, such as



The intelligent driving control system developed by WHU researchers is used in self-driving cars.



The robot designed by WHU researchers is capable of high-precision surveying and mapping.

electroencephalography (EEG). In an experiment using raw EEG data collected from children with ASD, the framework achieves an accuracy rate of 97%, a 10% improvement from the conventional diagnostic approach. The research has potential for making large-scale, high-efficiency ASD screening possible.

The WHU medical AI team also proposed new methods for non-invasive, quick screening of cervical diseases based on AI-assisted analysis of ultrahigh-resolution optical coherence microscopy (OCM) images. They developed a deep learning model that can automatically recognize cervical cancer cells. By working with a local company, Wuhan Landing Medical High-tech, their AI-assisted system is already used in cervical cancer screening programmes nationally. The system has improved screening quality and efficiency, at a reduced cost, having achieved even higher accuracy rates than diagnoses performed by experts.

The clinical use of AI is also demonstrated in a human-computer collaborative diagnosis system for infectious diseases. To ensure the quality of knowledge and the accuracy

of inference, the WHU team has proposed a novel 'lattice' inference technique, which is patented. It incorporates input from a group of top medical experts to make a knowledge database, which addresses weakness in current intelligent medical diagnosis systems. Their AI-assisted system can significantly lower the rate of misdiagnosis.

Intelligent video monitoring

Given the complex and dynamic environment of city blocks, person re-identification technology often gives false warning. Using deep learning techniques, WHU computer scientists have developed new algorithms for associating images of the same person taken from different cameras or in different occasions, leading to more reliable security monitoring, and publications in quality journals. In the 2016 TREC Video Retrieval Evaluation, organized by the National Institute of Standards and Technology in the US, the WHU team was rated first in all the experiments for real-example retrieval.

Their technology has set the foundation for developing intelligent highway and communication network-based self-driving systems.

The team has also studied robots and other unmanned systems, tackling core technologies for perception in complex dynamic scenes, precise location using multi-source sensors, and intelligent

navigation in complex environments. It has won several robotics and autonomous-driving competitions. Currently, the WHU team leads a project that sets national standards for digital maps to be used in high-precision navigation, supporting the industrial development of automatic driving, service or specialised robots, and other unmanned systems.

These studies are supported by computer vision researchers at WHU, who are dedicated to large, multi-scale, and precise 3D reconstruction. Their accurate and vivid 3D digital models of objects have seen applications in unmanned driving, virtual and augmented reality technologies, as well as 3D city modelling, advancing 3D reconstruction technologies.

Looking to apply these AI technologies to promote industrial innovation, the school has established a joint AI laboratory with xiaomi, a leading Chinese company in the smartphone industry, committed to basic research and development of key technologies related to AI. ■