

BEYOND ChatGPT: HOW AI IS TRANSFORMING OUR WORLD



Professor Stephen Roberts.
Credit: Mind Foundry Ltd.



Professor Shimon Whiteson.
Credit: University of Oxford



Dr Ross Upton. Credit: Ultramics.



Professor Charlotte Deane, Oxford University.



Associate Professor Sara Khalid.
Credit: Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, Oxford University.



Dr Joss Wright.
Credit: Oxford Martin School.



Professor Sandra Wachter.
Credit: Sandra Wachter.

Once the realm of science fiction, artificial intelligence (AI) technologies are becoming increasingly integrated into our daily lives with tools such as ChatGPT already revolutionizing how we communicate. But many other sectors are embracing AI to unleash new insights and greater efficiencies, including finance, transport, wildlife conservation, and healthcare.

THE FUTURE OF FINANCE

Machine learning methods and algorithms have been at the heart of the financial sector for many years, but the latest advancements are set to transform this industry, particularly insurance. Stephen Roberts, Professor of Machine Learning at Oxford University, explains: "Historically, insurance products have been broad-brush, catering monolithically for a wide range of customers, but we see a future where this is replaced by personalised, timely and flexible policies." Whether health, travel, or personal insurance, AI tools can generate more accurate risk estimates,

thus enabling firms to better understand customers and provide more informed and accurate pricing. As an example, insurance companies have realised that many vehicles are not driven all day every day and that some people drive more carefully than others. Combining computational methods with data from in-vehicle sensors could enable these factors to be effectively and rapidly priced into agile, dynamic premiums.

AI could also be a powerful weapon against fraud, thought to cost the UK around £190 billion a year (National Crime Agency). By monitoring immense volumes of transaction data, AI-powered tools can generate



AI can be used with telematics and in-vehicle sensors to help car insurance companies to understand their customers better.
Credit: Mind Foundry

real-time alerts of suspicious activity, prioritised according to the likelihood that these actually indicate incidences of fraud. Meanwhile, the ability of AI to model the complex interactions and underlying risks between assets and sectors could also help open up finance for more 'risky' ventures.

Nevertheless, the integration of AI with financial services presents risks. "Notable issues can arise when large-scale ultra-fast AI systems interact with one another. For instance, it has been suggested that 'black box' algorithms may be a confounding factor in market flash crashes" Professor Roberts says. "More work is undoubtedly needed to understand how AI systems, even if compliant in isolation, can interact to produce unstable markets and subsequent rapid losses."

DRIVERLESS DRIVING

Almost 30,000 serious or fatal road casualties occur each year in the UK, but autonomously driven vehicles could potentially make our roads much safer. Achieving this, however, represents "one of the most challenging engineering problems of our times," according to Professor Shimon Whiteson, from Oxford University's Department of Computer Science. Nevertheless, UK researchers have made great strides towards this goal.

In 2017, Professor Whiteson founded the company Latent Logic (acquired in 2019 by Waymo, part of Google's parent company), as a spin-out from his research into developing highly realistic simulation environments to train autonomous vehicle software. "The technology works by combining state-of-the-art computer vision with imitation learning. Our models extract the 'latent logic' behind real life examples of natural human

behaviour captured by traffic cameras and drone footage. As a result, the system can respond realistically even in new situations."



Waymo's autonomously driven Jaguar I-PACE electric SUV. Credit: Waymo.

This technology has now been integrated into the Waymo Driver – dubbed 'The World's Most Experienced Driver' – which has already logged more than 30 million autonomously navigated kilometres on public roads. "In a recent study, Waymo's safety team found that the Waymo Driver avoids more collisions and mitigates more serious injury risk than the high benchmark of an unimpaired human driver whose eyes are always alert to a potential collision" says Professor Whiteson. The company has also developed an autonomous ride-hailing service (Waymo One), currently operating in San Francisco, California, and Phoenix, Arizona.

Waymo now has ambitious plans for scaling and expansion. "Here in Oxford, we are focusing on enhancing the Waymo Driver's abilities using the latest advances in machine learning to develop more realistic models of the behaviour of other road users, including 'structured tests' which can simulate rare events that may only happen once in one million miles" says Professor Whiteson. "But to bring the benefits of autonomous driving technology to UK roadways, policymakers need to continue

investing in developing the talent and skills of the next generation of AI professionals, and put the legislation and regulation in place to enable the safe

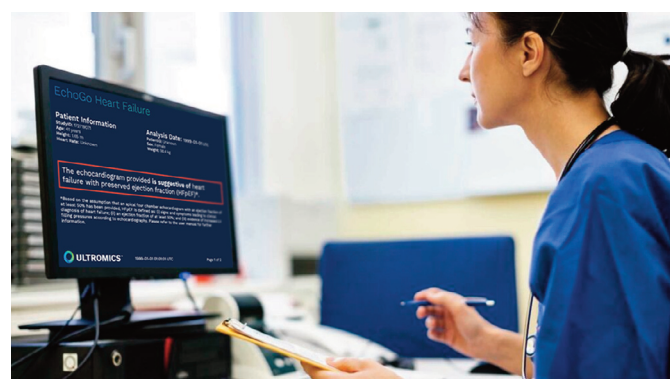
commercial deployment of autonomously driven vehicles."

DEFEATING DISEASE

Clinical AI applications, meanwhile, could help relieve the acute pressure on our public health systems by enabling more accurate and earlier disease detection, and thus early interventions. For instance, Ultromics, a medical diagnostics company that launched as a spin-out from the University of Oxford in 2017, has brought the power of AI into echocardiography for the early detection of heart failure

condition where the heart is unable to pump enough blood to meet the body's needs. HFpEF is extremely difficult to detect, and can often be mistaken for less severe conditions such as a chest infection. EchoGo can improve the accuracy of echocardiogram interpretation to above 90%; significantly better than the standard achieved by human doctors.

"By facilitating early diagnosis and treatment, we can improve the lives of many and help to reduce the significant burden heart failure has on the NHS, including identifying patients earlier in the pathway before they are admitted to hospital" says Ultromics CEO Dr Ross Upton. Ultromics is currently conducting clinical trials across 20 NHS hospitals to start bringing the technology to the UK but according to Dr Upton more support is needed from policy makers before AI models can truly transform care pathways. "This includes making it easier for NHS sites to procure and test AI models within their hospitals, reducing the barriers for adoption, and setting aside a ring-fenced budget for testing new technologies."



Clinician viewing report sent by Ultromics' EchoGo Heart Failure. Credit: Ultromics.

conditions. The company's EchoGo Heart Failure product uses a deep learning model to detect whether a patient has heart failure with preserved ejection fraction (HFpEF), a

Elsewhere, studies led by the University of Oxford have demonstrated the ability of machine learning tools to analyse electronic health records to predict the risk of emergency

hospital admissions; to track disease deterioration in cystic fibrosis patients; and to identify key developmental features of babies during routine ultrasound scans of pregnant women. Beyond diagnostic tools, AI can also help patients to manage existing conditions. As an example, GDM-health, a software application developed by Oxford University NHS Foundation Trust and the University of Oxford, helps pregnant women suffering from gestational diabetes to monitor their blood sugar levels and share that information in real time with a clinical team. Data recorded from the user's blood glucose meter are analysed by an algorithm to identify the patients most in need of clinician input, with staff able to communicate directly with patients through the system.

Meanwhile, when it comes to discovering new clinical treatments, "AI has the potential to change the game – to make drug discovery quicker, cheaper and more effective," says Charlotte Deane, Professor of Structural Bioinformatics at Oxford University. For instance, when a new target for therapeutic intervention is identified, AI can accelerate the process of searching for potential drug molecules. "This search space is vast – estimated at around 10 to the power of 60" says Professor Deane. "But AI can explore this space in a way humans and other types of algorithms cannot. As an example, AI algorithms borrowed from image processing have been used to predict with high accuracy how well a potential drug molecule will bind to a given target."

SAVING SPECIES

AI-enabled technologies could also help us combat the alarming disappearance of animal and plant species across

the globe. Two critical actions, for example, are to locate undiscovered species before they disappear and identify biodiversity hotspots to prioritise for protection. By combining machine learning approaches with advanced camera technology, researchers can now autonomously classify enormous volumes of images and video footage that would be beyond human capacity to analyse. For instance, Associate Professor Sara Khalid from the University of Oxford's Planetary Health Informatics Group recently assisted a National Geographic Society expedition using an AI tool that could automatically



An AI powered Shark Detector can identify 47 different species with up to 98% accuracy. Credit: Sara Khalid.

locate and classify shark species from underwater video footage. "We trained the algorithm using sharkPulse: a public repository of thousands of shark images submitted by citizen scientists worldwide" she says. The resulting 'Shark Detector' is capable of identifying 47 different species, with up to 98% accuracy.

"We are now exploring potential wider applications of this technology" Dr Khalid adds. "These could include identification tools to help fishermen avoid catching endangered species by accident, or autonomous monitoring systems to check for illegal fishing activity."

Besides counting and monitoring species, AI could help combat the root causes of biodiversity loss, as Dr Joss Wright from The Oxford Martin Programme on the Illegal Wildlife Trade explains: "AI-powered technology is revealing new insights about the illegal wildlife trade, helping us to understand why so many communities depend on it and what incentives might make wildlife more valuable to local people alive than dead."

One of the programme's projects, for instance, used machine learning methods to analyse over 27,000 patents

people's attitudes towards threatened species.

"A particularly exciting project we are currently working on combines AI-enabled technologies with conservation science to mine open-access data and derive the biodiversity impacts of investments" adds Dr Wright. "This will allow investment fund managers to obtain a 'biodiversity risk score' for a portfolio, and thus to assess their investments in terms of their risks to biodiversity."

NEW TECHNOLOGIES, NEW RISKS

The increasing integration of AI-

driven technologies into our societies is already causing ethical issues, as Professor Sandra Wachter, from the University of Oxford's Oxford Internet Institute, explains. "AI technologies are powered using huge amounts of data, which immediately creates a data privacy issue. Algorithms are very good at inferring something about you from data that initially seems harmless, and this can include sensitive information such as sexual identity and health conditions." In addition, because AI algorithms are trained using historical data from the internet, they can inherit and reinforce biases and discrimination, for instance on gender and traditional job roles.

“This could lead to people who already experience discrimination becoming even more disadvantaged, particularly women and people of colour.”

Where algorithms are used to make important decisions, explainability becomes another key issue. “Very few people really understand what happens inside the ‘black box’ of AI” Professor Wachter explains. “If, for example, you were sent to prison or denied a job because

of a decision made by an algorithm, it might not be possible for you to be given an explanation why. Even if those responsible know, the code may be a trade secret.”

Meanwhile, generative AI technologies such as ChatGPT are accelerating the speed at which convincing disinformation can circulate. Besides spreading doubt on issues such as climate change and vaccine efficacy, this could reduce public trust in

media and political institutions, allow generation of propaganda, and be used to sway elections.

According to Professor Wachter, the potential far-reaching consequences of AI make it imperative that regulation is not left to the private sector. “As a minimum, governments should invest in increased horizon scanning capacities to identify disruptive technologies early in their lifecycle, so they aren’t blindsided by new

developments. Regulators should work more closely with independent academics and researchers, to assess the risks and benefits to create evidence-based guidelines that enable ethical innovation. We also need to invest urgently in early and continual education, so that people making high-stakes decisions in the future – whether doctors, journalists, politicians or judges- are able to discern what is true from what isn’t.” ■