# A difficult road ahead?

The dream of automated cars that drive themselves could still be a long way from becoming a reality, explains **Professor Neville Stanton** in this year's Broadbent Lecture

Automated vehicles are the holy grail of transport technology. They conjure up a vision of drivers reading, watching videos or sleeping as they are transported effortlessly and safely to their destination.

It's an attractive concept, but it's almost certainly illusory, and at this year's CIEHF conference, a highly respected expert in human factors engineering will explain why. Rather than offering comfort and security, he will tell delegates, they currently have an alarming propensity to crash.

Neville Stanton is Professor Emeritus at the University of Southampton and has been researching the effect of automated driving on vehicle occupants for more than 30 years. He has concluded that the people using this technology are actually less able to respond in an emergency than if they were driving manually and will discuss his work in this year's Broadbent Lecture.

"They believe that the system is failsafe, but it isn't", he explained. "We're going to see far more crashes and people dying. It's going to get worse before it gets better."

Professor Stanton began his studies of vehicle automation in the early 1990s, when he was asked by Jaguar Land Rover to take part in a project looking at risk from a human factors perspective. "It was in the very early days of the automated vehicle", he recalled. "They took me onto a test track in a Jaguar XJ. It had a boot full of computers and they said one day they would be replaced by a single chip. They asked me to let the car drive itself and it was pretty scary."

The idea then, he added, was for the control engineers to design out the humans as they were thought to be error prone. He told them that the nearest analogy at the time was the fly-by-wire technology used in aircraft. They needed to look at what went wrong in these and try to apply those lessons to driving.

Worryingly, on studying this he and his team found that automating flying led to pilots losing the skill of controlling and landing planes. "We found examples where aircraft fell out of the sky because automation was handed to the pilot and they weren't ready to take control.

"The issue was the communication between the autopilot and the human. The technology didn't tell the person what was going on. Another problem in aviation was that the automation never lived up to its promise as the designers couldn't imagine all the possible scenarios it might have to face."

It was shown decades ago, he added, that the things that are easy to automate are automated, while difficult things are left alone. "That's the wrong way around. Cars are suffering the same problem."

He gave an example – motorway driving is straightforward and fairly predictable, but junctions, single carriageway roads and urban environments are more challenging because more things are going on.

"It's where people crash – these environments are incredibly difficult to automate. Humans are not good at constant and prolonged vigilance tasks."

There is a problem, he added, of automation paradoxically causing both too little and too much workload. "Motorway driving is boring, and people can't maintain their attention for long. Automation when working perfectly is extremely dull, so they turn to other distractions such as smartphones.

"However, when the automation fails, drivers are faced with a problem of trying to interpret what's going on and taking over very quickly. On motorways you can have as little as a second between you and the vehicle in front. Our studies show you need about 30 seconds.

"With automation, you have to decide whether you need to intervene all the time. That's the job the engineers are expecting you to do, but they have misunderstood the demand this places on people. They have not understood that watching automation is actually

much more mentally demanding than driving the vehicle yourself."

Another problem Professor Stanton identifies is that of so-called mode confusion, where the controller thinks that the technology is in one mode when it is in fact in another. This means that the human prediction of how the machine will behave is completely wrong.

He gives the example of when an Airbus A320 first demonstrated automation at the Paris Air Show. "It flew into the ground. No one could figure out why an automated aircraft crashed itself. The reason was because they were doing a low flight pass to show it off. The aircraft thought it was going into landing mode." The modern automated vehicle can have a similar problem. "It has two modes – keep-in-lane mode, where it stays between the white lines and holds its speed, and follow mode, where it remains behind the car in front.

"That works quite well when you are on a motorway. However, we carried out a test in urban environments. We found that people do all sorts of things that the manual tells them not to – even watching videos – because they experience high reliability in the vehicle and believe that the system is fail safe.

"It isn't. When we tested this, we found that the car went from keep-in-lane mode into follow mode, so when the vehicle in front of us pulled into a lane to turn right, we followed it, even though we wanted to go straight on.

"The car isn't designed to tell you what mode it's in, so to manage it properly, you have to know intuitively. People get confused about if they are meant to be driving it or if it's driving itself."

His research has highlighted the problem of car occupants becoming distracted when the car is in an automation state. "After a while they picked up their smartphones and started playing with them. That happened even after the benefit of proper training."

Even when the technology does work, it has limitations: heavy rain affects the vision systems and LIDAR, and snow, fog and bright sunlight can also affect performance. "There's a long way to go before the technology can operate optimally. It could be as little as 20 years or as many as 100. These vehicles are not going to be driving competently by themselves around towns and villages anytime soon." ■

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## Automation

EHF2022 keynote speaker Dr Alonso Vera, Chief of the Human Systems Integration Division at NASA Ames Research Center in California, will also explore issues of automation in his conference presentation. He has been at the space agency for more than 20 years and worked on the development of software and systems for missions including Mars Exploration Rovers, the Space Shuttle and the International Space Station.

His talk, Engineering Intelligent Systems Around Human Capabilities, will discuss the work being carried out at NASA to identify the needs of the next generation of intelligent systems so they can support the exploration of space.