FLIGHT FANTASTIC

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Instead of rewiring planes to fly themselves, why not give them android pilots?

THE idea of a drone—an aircraft designed from scratch to be pilotless—is now familiar. But what if you want to make pilotless a plane you already possess? Air forces, particularly America's, sometimes do this with obsolete craft that they wish to fly for target practice. By using servomotors to work the joystick and the control surfaces, and adding new instruments and communications so the whole thing can be flown remotely, a good enough lash-up can be achieved to keep the target airborne until it meets its fiery fate.

The desire for pilotlessness, though, now goes way beyond the ability to take pot shots at redundant F-16s. America's air force wants, as far as possible, to robotise cargo, refuelling and reconnaissance missions, leaving the manned stuff mostly to its top-gun fighter pilots. This could be done eventually with new, purpose-built aircraft. But things would happen much faster if existing machines could instantly and efficiently be retrofitted to make their pilots redundant.

Shim Hyunchul and his colleagues at KAIST (formerly the Korea Advanced Institute of Science and Technology) think they can manage just that. They plan to do so by, quite literally, putting a robot in the pilot's seat. As the photograph shows, this robot—called PIBOT (short for pilot robot)—has a human body plan, with a head, torso, arms and legs. The head is packed with cameras, which are thus in the same place as a human being's eyes, and the arms and legs can

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operate an aircraft's controls, just as a human being would.

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To design PIBOT, Dr Shim and his colleagues broke the task of piloting down into three areas—recognition, decision and action. They then developed the machine intelligence and sensory software needed for a robot to carry all three out well enough to fly a plane.

The recognition part was fairly easy. Trainee pilots have to learn to ignore irrelevant stimuli and concentrate on the instruments, which is trivial for a robot. And most recognition tasks during flight involve reading simple text displays and markings, tasks for which modern optical-recognition software is more than adequate. For looking out of the cockpit, meanwhile, PIBOT has edge-detection software that recognises features like the horizon and runway markings.

Decision-making is similarly simple to program in. Here, PIBOT works like a standard autopilot, following the rules set down in the handbook of whichever aviation authority has to approve it. Programming in the actions consequent on these decisions, though, was trickier. Every such action—for example, flicking a particular switch or moving the joystick a prescribed amount—has to be expressed as a combination of arm- or leg-joint movements that have to be calculated precisely and then added to the robot's memory.

The first PIBOT, a scaled-down version based on a commercially available 'bot called BioLoid Premium, was demonstrated in 2014. Though just 40cm tall, this had the same articulation as a full-sized device. When strapped into a cockpit simulator with miniature controls, it was able to go through a complete flight sequence, from turning on the engine and releasing the brakes to taxiing, taking off, flying a predetermined route and landing safely at the destination. Crucially, it was then able to do the same in a real, albeit miniature aircraft—though it needed some human assistance with the tricky procedure of landing.

Now, Dr Shim has unveiled PIBOT2, a full-sized version of his invention. This flies a simulator as

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well as its predecessor did, though it has yet to be let loose in a real cockpit. If it can outperform that predecessor in the landing department, then it will fulfil the United States Air Force's requirement for a "drop-in robotic system" that can be installed quickly without modifying an aircraft—and will do so at a unit cost of $100,000, which is $900,000 less than the cost of converting an F-16 for a trip to the great shooting gallery in the sky.

From an air force's point of view there is a lot to like. PIBOT's autonomy removes the risks of jamming or loss of a communication link that goes with remote control. The robot is immune to g-forces, fatigue and fear, requires neither oxygen nor sleep, needs only a software download—rather than millions of dollars of flight training—to work out how to pilot an aircraft, and can constantly be upgraded with new skills in the same way.

Moreover, Dr Shim sees the military use of PIBOT as just the beginning. It could also provide an economical replacement for a human co-pilot on commercial flights. It could revolutionise ground transport, too—providing, as an alternative to purpose-built driverless cars, the possibility of a robo-chauffeur. Dr Shim says he is already working on a PIBOT able to drive a car, a task which is, he says, "easier in some parts and more difficult in others" than piloting a plane. If successful, this approach could turn millions of existing vehicles into driverless ones quickly and easily. And the owner could still put the robot in the back seat (or even the boot) whenever he wanted to experience the old-fashioned thrill of taking the wheel himself.

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