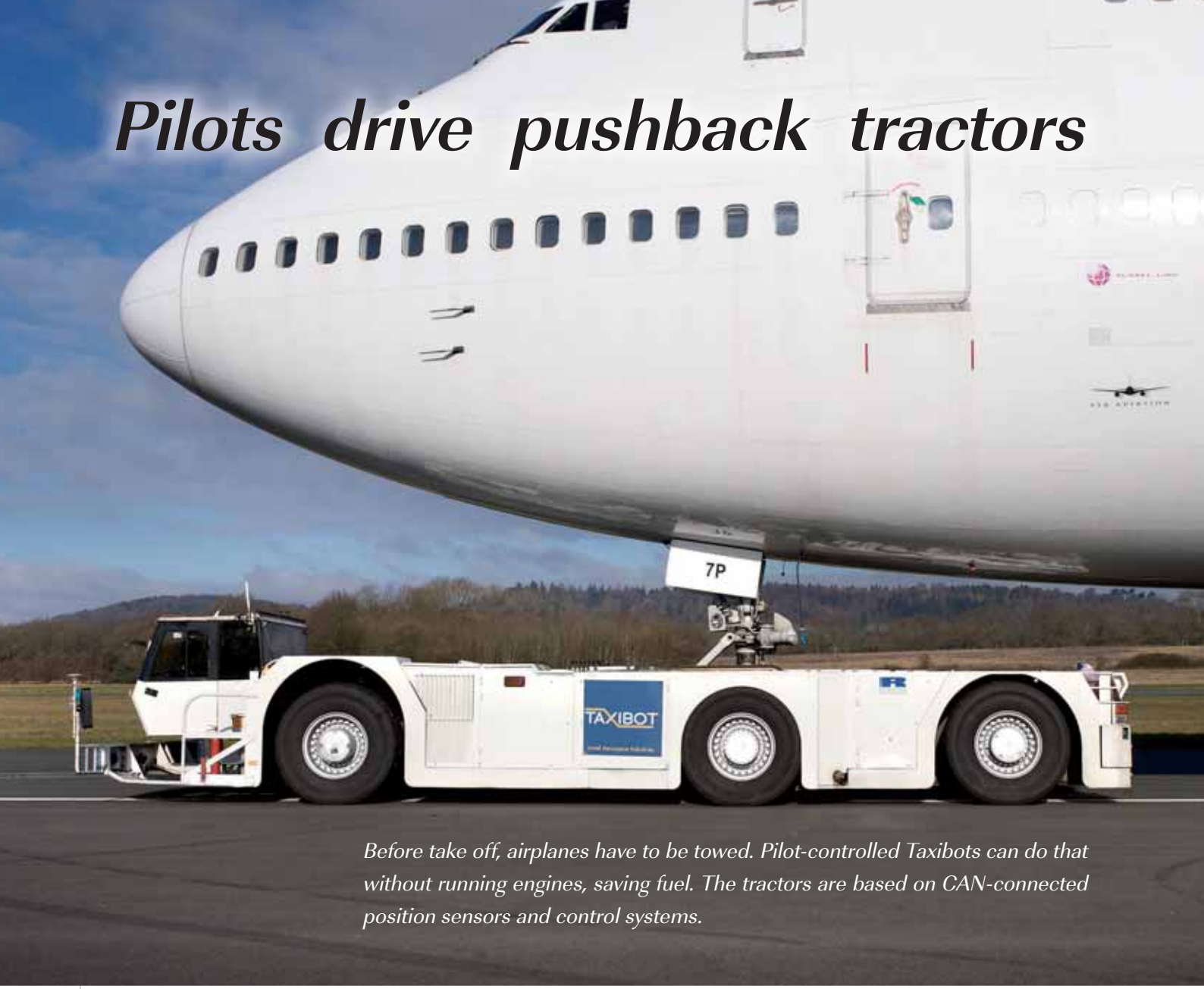
Pilots drive pushback tractors



Before take off, airplanes have to be towed. Pilot-controlled Taxibots can do that without running engines, saving fuel. The tractors are based on CAN-connected position sensors and control systems.

Links
www.dintec.fr
www.iai.co.il
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Airplanes taxiing on taxiways in airports burn a large amount of fuel, emit tons of CO_2, and are very noisy. Israel Aerospace Industry (IAI) developed a towbarless towing tractor – the Taxibot (Taxiing Robot). It is a semi-autonomous vehicle that enables airplane taxiing without engines running, controlled by the pilot, and without shortening nose landing gear life-time. Because the vehicle does not use the airplane's power resources for taxiing, the fuel consumption is reduced as well as the CO_2 emissions. According to the manufacturer, the Taxibot reduces cases of FOD (foreign object damage) by 50 percent, and decreases noise and gas pollution.

The vehicle developed by IAI provides the required power to move the airplane, without the need to change or replace the airplane's APU (auxiliary power unit). It allows the pilot full control of the system. The system uses the airplane's tiller and brake pedals like in regular taxiing. Pilot training is therefore minimal.

Dintec has developed the steering-by-wire subsystem implemented in the Taxibot tractors. The airport tractor is available in two versions: Narrow-Body (NB) and Wide-Body (WB). This summer, the pilot-controlled vehicle completed the certification tests at Frankfurt Airport. The tests were conducted with a Lufthansa B737 airplane in accordance with the official EASA and CAAI flight governing authorities. The system also works with Airbus 320 aircrafts.

Steering-by-wire

In order to fulfill safety requirements, the French sub-contractor of the steering-by-wire system selected the ESX 3XM controller by STW (Sensor-Technik Wiedemann). The controller provides six CAN interfaces and runs different higher-layer protocols (CANopen, J1939, and a proprietary safety protocol). The towbarless tractor uses different steering angles for different airplanes.

All participants of the steering-by-wire system are connected to two CAN networks: “Primary CAN” and ▷

"Emergency CAN". Both run at 500 kbit/s. The utilized proprietary safety protocol is based on a single CAN message transmitted periodically. It contains up to 3 byte safety data. In the very same frame another 3 byte contain the bit-wise inverted safety data. Additionally, these 6 byte are protected by a CRC (cyclic redundancy check), which is also transmitted in the very same CAN frame. The German TÜV has approved this ECU's protocol for SIL-2 (Safety Integrity Level) according to IEC 61508. The protocol runs on two CAN networks. The multiple CAN network approach increases the availability of the steering-by-wire system. The master controller is redundant and also communicates via CAN with the wheel-controllers. All controllers also use one other local network to connect CANopen Safety sensors measuring the wheel position.

The steering-by-wire system by Dintec implements a triplicated steering-wheel sensor, a redundant force feedback actuator and redundant actuators with cross monitoring in each wheel of the tractor. The controller features a 10-ms main-loop and 5-ms sub-loops. It also controls the suspension.

At the Mobiltron 2014 seminar organized by STW, Anthony Dollet from the Dintec group explained the steering-by-wire system in detail: "We were looking for a scalable hardware to implement master and slave controllers with the same software and online configuration." The software running on the ESX 3XM controllers was programmed in C, in order to reuse existing software parts and already existing code generation tools.

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