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Taxi Tech

Shh! Unbeknownst to passengers, emerging fuel-saving aircraft taxi equipment is making that crucial trip from the apron to the runway safer *and* quieter.

BY HOWARD SLUTSKEN



PHOTO: TAXIBOT



ABOVE At Frankfurt Airport, operators ready TaxiBot for narrow-body and, **TOP**, wide-body aircraft. **BELOW** A close-up of the mechanism on a cradle being tested on an A320.



Since November 2014, passengers flying from Frankfurt Airport on Lufthansa's Boeing 737s have been the first in the world to experience an innovative technology without, perhaps, even realizing it. The airplanes have been pushing back from the gate and taxiing to the runway as usual. But on these flights, the 737s have been rolling from the ramp to the runway without using the aircraft engines. Under the control of the pilots, the jets are being towed by a semi-autonomous aircraft tractor called TaxiBot.

Israel Aerospace Industries (IAI) led the development of TaxiBot, along with Airbus, Lufthansa LEOS, and ground-service equipment manufacturer TLD Group. With a different approach, competing systems in development by WheelTug, electric green taxiing system (EGTS) by Honeywell, Safran, and Technodinamika instead add pilot-controlled electric motors to an aircraft's landing gear. But all of the concepts give an aircraft the ability to taxi without engines running, making airports quieter and safer.

The technology is also a big nod to the industry's global mandate to use less fuel.

ELECTRIC DRIVE

From the outside, TaxiBot looks similar to a widely used wheel-lift aircraft tractor, but is a completely new vehicle, according to Ran Braier, program director at IAI, which owns TaxiBot International. "Normally, this kind of tow tractor has a hydrostatic drive. In the case of TaxiBot, the driveline is electrical. The reaction time of the electric driveline is much better," says Braier. "Since we need to very carefully maintain the load on the nose landing gear in a narrow envelope, we need a very fast reaction time."

When it's ready to roll, the aircraft's nose gear is lifted up in TaxiBot's specially designed, sensor-laden cradle. Working with the ramp crew, a safety driver performs the pushback and then switches control of TaxiBot to the pilots. "Going forward is similar to an automatic car in drive gear. When you release the brakes, the vehicle starts to move forward. TaxiBot is exactly the same," explains Braier.

The tractor knows how fast to go, thanks to a precise navigation system that's programmed with the airport's taxiway speed limits. TaxiBot senses when the pilot applies the aircraft's brakes and does the same to the tug. When the pilot maneuvers the nose wheel's tiller control for a turn, TaxiBot measures the rotation of the nose gear and moves the tractor's all-wheel steering to match the precise turning characteristics of the aircraft. "We want to give the pilot the same feeling as normal taxiing, so the pilots don't need special training," says Braier. Once at the runway, the aircraft is released, starts its engines – and takes off. Pilots will also have

the option to start the airplane's engines while on the cradle.

To convoy a fully loaded Boeing 737 or Airbus A320, TaxiBot has an 800 hp powerplant, compared with 150 hp in a normal tow tractor. Why? "We need to bring the airplane to the same taxiing speed as if it were doing it on jet engine power," says Braier. "Normal tractors in pushback are traveling 5-7 km/h, and they cannot take a fully loaded airplane to 42-43 km/h like TaxiBot." With the main engines off, and only the airplane's auxiliary power unit (APU) running, Braier says TaxiBot will save 85 percent of the fuel burn during taxi.

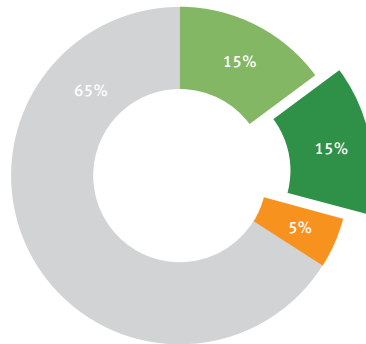
Lufthansa is dispatching aircraft every day at Frankfurt Airport using TaxiBot. At a major airport like FRA, Braier suggests that somewhere between 70 and 85 percent of the ground operations could be done by TaxiBot. "The rest would be using conventional tractors," he says.

Testing has begun on a 1,500 hp, 12-wheel-drive, all-wheel-steering TaxiBot for wide-body aircraft, covering airplanes from the Boeing 767 to the Airbus A380. The first airplane to be certified will probably be the 747, Braier says. But for airlines operating at airports where TaxiBot isn't available, other suppliers are hoping to meet the same fuel-saving objectives by installing a self-contained electric-drive system on an aircraft's landing gear.

It's Not Just Wheels and Motors

In the past 10 years, approximately 825 individual patent applications have been made pertaining to aerospace eTaxi technology. But it's not just wheels and motors that are being patented.

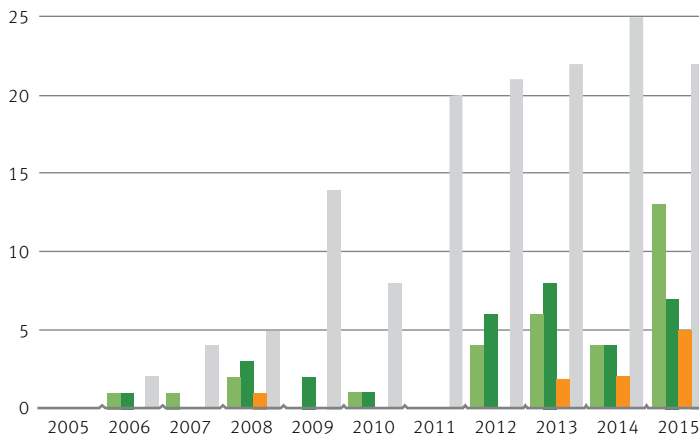
Aeropatent.com breaks eTaxi patents down into four different categories: mechanical and electronic elements pertaining to system architecture, the pilot's flight deck control and display, operational procedures relating to commercial use of eTaxi systems, and other niche technologies related to research and development.



- System Architecture
- Operational Procedures
- Flight Deck Control & Display
- Niche Technologies

NEWLY PUBLISHED PATENT FAMILIES – BY TECHNOLOGY SECTOR

- System Architecture
- Operational Procedures
- Flight Deck Control & Display
- Niche



SOURCE: AEROPATENT.COM

AUXILIARY POWER

Honeywell and Safran's EGTS was first demonstrated to the public at the 2013 International Paris Air Show. An Airbus A320 had an electric motor installed on one wheel of each of the main landing gear, with power coming from the airplane's APU. With engine inlets covered, the taxiing A320 was controlled from the cockpit through a pilot interface unit. The EGTS aircraft has logged more than 1,500 kilometers of rolling tests, including pushback, tight turns and U-turns, in various load configurations and runway conditions.

"EGTS is compelling, but a complex technology to implement in existing aircraft, while minimizing the aircraft modifications required," says the EGTS team. Since the 2013 demo, the team has "remained focused on our development work with Airbus and our testing partners as we work towards a firm launch date." >

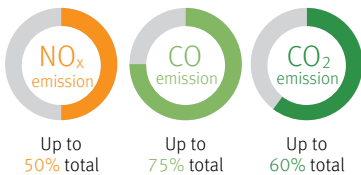
"Can the electric motor move the aircraft? Check! Can it move aircraft in snow? Yes!"

ISAIAH COX
WHEELTUG

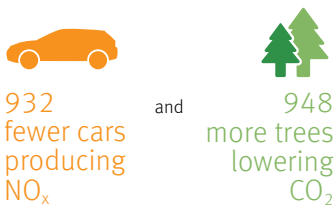


LEFT Honeywell and Safran's EGTS uses the auxiliary power unit to power motors on the main wheels. **TOP** The WheelTug system during ground testing in Prague.

When compared to dual-engine taxi operations, Electric Green Taxi Systems (EGTSs) deliver considerable reductions in emissions of nitrogen oxide, carbon monoxide and carbon dioxide:



One aircraft equipped with an EGTS is the equivalent of:



FUEL EGTS can deliver up to 4% savings of total block fuel consumption.

And, at Moscow's MAK-2015 air show, Russia's Technodinamika announced it is also developing an "electrical ground taxiing system." The diverse aviation company calls it "the first development of its kind in Russia to date."

TOWING THE NOSE

Gibraltar-based WheelTug has developed electric motor technology for a nose gear installation. CEO Isaiah Cox says, "We had a list of showstoppers that we had to deal with. Can the electric motor move the aircraft? Check! Can it move the aircraft in snow? Yes! Can it fit inside the [nose] wheel? That's trickier, but we got there."

After initial tests in 2012 on a Germania Airlines 737, WheelTug is now undergoing extensive testing in a sophisticated dynamometer, which simulates and measures operational tests. Cox laughingly calls the device the "Iron Foot," paying homage to a ground-bound Iron Bird often used in aircraft testing. "It allows us to duplicate the resistance of going uphill or downhill, of different traction or thermal conditions and varying contact pressures," says Cox. A WheelTug installation will include a camera system called TaxiCam, giving the pilots situational awareness around the aircraft. According to Cox, close to 1,000 WheelTug systems have been ordered by 22 airlines.

Like the other systems, WheelTug will reduce emissions, fuel burn and noise; improve ramp safety; and eliminate expensive damage from foreign-object debris during taxi by not having the engines running. Cox also identifies a potential time benefit to an airline and its passengers by eliminating the time taken by a pushback tug to disconnect. And, in a throwback to the early days of jet travel, Cox suggests that WheelTug-equipped aircraft could park *sideways* at a terminal, a manoeuvre he calls "the twist." With jet bridges at both the front and back aircraft doors, turnaround would be quicker, saving up to 20 minutes per cycle.

WheelTug's entry into service is still a couple of years away, according to Cox. "We've been preparing for the formal submission to the Federal Aviation Administration, for the formal launch and certification process," he says. Canada's Air Transat is expecting to provide a Boeing 737 for certification testing, and the airline plans to install WheelTug on its permanent fleet of 737s.

Keith Lawless, Air Transat's senior director, Business Sustainability and Improvement, says, "We believe that the WheelTug will save us money by saving fuel, maintenance costs and ground-handling costs. It will benefit the environment by reducing [greenhouse gas] emissions. Finally, we believe that it will provide an operational advantage by enabling us to perform faster turnarounds." ■

PHOTOS: EGTS, WHEELTUG, ICONS MADE BY FREEPIK FROM FLATICON.COM