

A new kind of TURBOPROP and a 3D-printed prototype

A childhood love of turbines led to the design and eventual 3D printing of an unusual aircraft engine that blends three distinct technologies. Nino Caldarola, an application specialist at Autodesk reseller Imaginit Technologies, Winnipeg, Manitoba, Canada, says "The idea for my current design arose while looking at 1940s and 50s jet engines. The Rolls-Royce RB.168 Nene's incredible intricacy caught my eye. The front section of my initial engine used a lot of Nene elements. The challenge I had set myself was to model the complex assembly using modern 3D MCAD software. But then I decided to see what would happen in connecting the old technology to a

The complete engine prototype clearly shows the contrarotating propellers. The prototype is 10-ft long, with a blade span of 11.5 ft — probably one of the largest prototypes to be built to date.

Rapid prototyping helped an engineer confirm his design of an advanced turboprop, which blended elements of a '40s jet engine, a modern gearbox, and contrarotating propellers.

modern mechanism more familiar to me — the gearbox."

The gearbox thus became the second component of his engine design. Caldarola says he based the gearbox on that of Pratt & Whitney PT6-type engines. "The engines are found on a lot of modern turboprop aircraft called 'city hoppers,'" he says. "I liked the engine because it is a tight package." This is because the gearbox is a double-reduction system. It couples to the turbine through a smaller gear that converts the high rpm, low-torque output of a large gear to the low rpm, high-torque output needed to drive the propellers.

The third component of the design was inspired by the contrarotating propellers found on engines such as the Soviet turboprop Kuznetsov NK-12, says Caldarola. Here, two propellers are arranged one behind the other. "At first, I added the rotational component mainly to see if the design was feasible," he says.

To put a historical perspective on his design, when

Authored by:

Leslie Gordon

Senior Editor

leslie.gordon@penton.com

Resources:

Autodesk Inc., www.autodesk.com

Imaginit Technologies, www.rand.com/imaginit/1/index.htm

Stratasys Inc., www.stratasys.com

Watch a video of the turboprop's design and prototype assembly process: <http://tinyurl.com/y1z9pow>



A total of 188 3D-printed parts for the prototype of Caldarola's unusual engine design are stacked waiting for assembly. The parts were later attached with industrial-grade bolts.

the jet revolution came about, everybody was designing for turbojets, says Caldarola. Until the advent of 707s and DC8s, most of the aircraft at that time used surplus World War II piston engines, continuations of what aircraft engines were from the start. Then Rolls-Royce got the idea of replacing the heavy, out-of-date engines it was using on large transports — the engines had peaked in power.

"The idea was to get more power out of a lighter package," explains Caldarola. So Rolls-Royce attached a gearbox in front of the turbojet engine and coupled this gearbox to a propeller. Suddenly, the company had a new product known as the Rolls-Royce Dart.

"The Dart stayed in production for a long time and is still used by a lot of transport and passenger aircraft in the



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