

Alternative to helicopter: a cyclocopter for special cases

The French-Canadian and Humboldt Fellow Louis Gagnon is a guest researcher at the Institute of Aerodynamics and Gas Dynamics.

The research of the mechanical engineer Dr. Louis Gagnon aims high into the air. Gagnon wants to build an electric flying machine that takes off vertically like a helicopter, but is more maneuverable and compact - and all this with the lowest possible energy consumption. This is to be made possible by an alternative, so-called cyclorotor. The name of the aircraft is also derived from it: Cyclocopter.

Focus on energy efficiency

The topic of energy efficiency runs like a red thread through Gagnon's research career. As a mechanical engineering student in Montréal and Québec City, he participated in racing car competitions and, together with his team, received an award for the most fuel-efficient vehicle. During his master and doctoral studies at Laval University of Québec City, he focused on cars and trucks. Among other things, he investigated which factors influence energy consumption. This also led to his contact with the Milan Polytechnic, where he was a guest doctoral student studying multi-body models of trucks. "Like me, many people love the freedom that comes with mobility, but it hurts me to see the impact it has on the climate," says Gagnon.

The Helicopters and Aeroacoustics working group, headed by Dr. Manuel Kessler, was recommended to him through his former boss at Milan Polytechnic. "I've never built an aircraft before and I get a lot of support from my colleagues who have experience in this field," explains Gagnon. He says that it's easy to get along with them, and that people go out for lunch together and regularly discuss research projects. "It's remarkable how quickly Louis Gagnon managed to communicate in German without any problems, even in demanding technical discussions," says Kessler, impressed.

A year ago, Gagnon first moved to Mannheim, where he and his Italian wife spent four months attending an intensive German course financed by the Humboldt Foundation. "With our then five-month-old son, it was a challenge at first," says Gagnon in German with a French accent. In looking after the offspring, the couple took turns with the grandparents, who had travelled from Italy and Canada for this purpose. The family now lives in Möhringen, from where Gagnon usually rides his bike to the campus in Vaihingen.



Figure 1: Louis Gagnon with the wooden model of a cyclorotor.

Rotor resembles paddle wheel of a paddle steamer

What Gagnon lacks in practical knowledge about aircraft construction, he makes up for with his six years of research experience on cyclorotor engines in Italy. To explain how a cyclorotor works, the 36-year-old likes to use a wooden model the size of a palm of his hand. He recently built it in the institute's workshop. The rotor resembles the paddle wheel of a paddle steamer, where the blades are replaced by blades. The blades rotate along their long side around a horizontal axis, thus generating lift and thrust.

In addition, the angle of inclination of the rotor blades can be changed so that thrust can be generated in different directions. "This is a major advantage over the conventional helicopter rotor, which mainly generates thrust downwards," says Gagnon. Used as a crane, cyclocopters could therefore switch seamlessly from hovering to forward flight and maneuver their load to be carried much more precisely through narrow construction sites. Finally, the concept allows the construction of very compact and quiet aircraft. This also makes the devices interesting as future air taxis for flying between the high-rise canyons of large cities.

Over 100-year-old concept revived

"The classic helicopter is mature and works well, but the cyclocopter concept is definitely interesting for special applications," says Manuel Keßler. However, he still sees a "considerable need for research" into cyclocopters. Although the first cyclocopters were built as early as the beginning of the 20th century, helicopters came along and the concept was not pursued further. By contrast, cyclocopters have proven their worth to this day in harbor tugs or ferries, which have to be extremely maneuverable. In the meantime, there are again a few companies and research groups worldwide that want to develop lighter cyclorotors for flying objects.

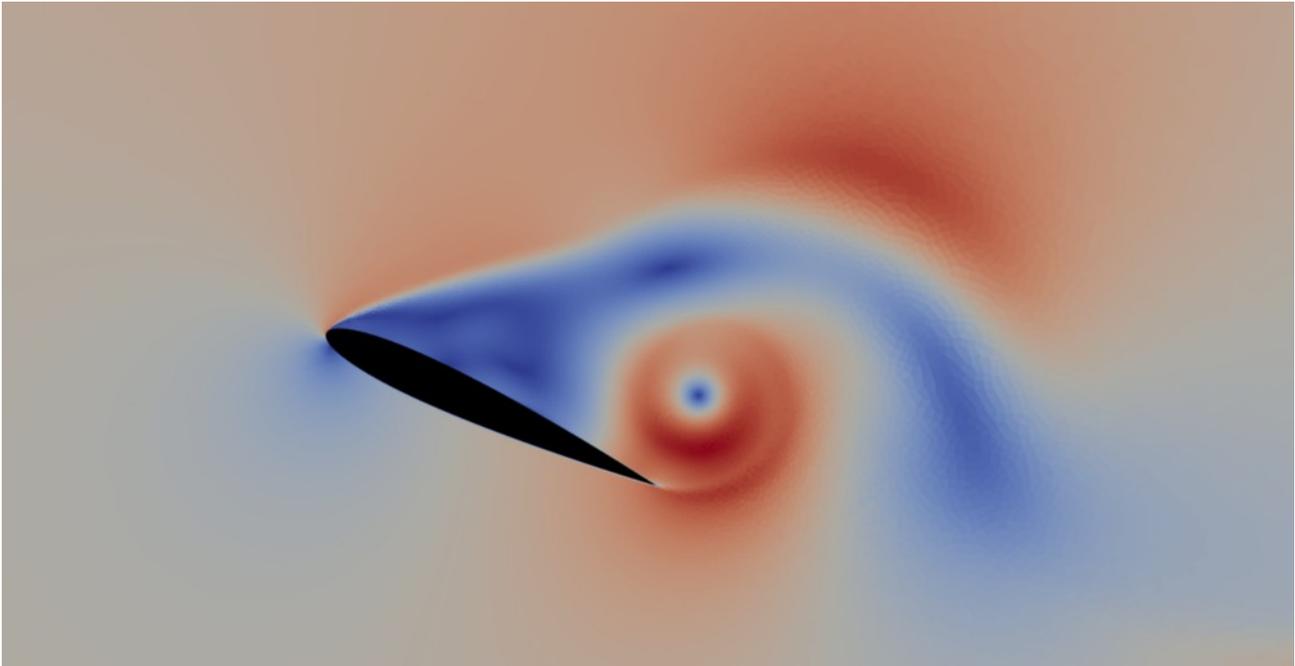


Figure 2: Computer simulation of air flows along a rotor blade.

In order to be able to test and optimise different rotor designs on the computer in advance, Gagnon has already developed various simulation models for cyclorotors in the Aerospace Engineering department at the Milan Polytechnic. The mechanical engineer uses multibody simulations to investigate, for example, how the individual rotor components interact with each other. Methods of numerical fluid mechanics, on the other hand, allow a detailed view of the air flows and vortices along the blades.

Flying is beautiful - but please save energy

Among other things, he used these methods to analyze the aerodynamic rotor properties in an unmanned prototype of an Austrian partner company. "The goal was for the cyclocopter to fly," says Gagnon. "Now I want to build a cyclocopter that requires less power for the same weight as a conventional helicopter," he emphasizes. To do this, he needs more precise simulation models, which he plans to develop during his 2-3 year scholarship. Gagnon finally wants to test the most energy-efficient rotor configuration determined on the computer in a self-built prototype.

[Working group: Helicopters and Aeroacoustics](#) (internet link)

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