

## New research could herald revolution in flight systems

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Everyone knows the story of how the Wright brothers, Orville and Wilbur, were responsible for inventing and building the world's first successful aircraft. Now a new research project is attempting to follow in the brothers' footsteps by restating their most basic principle – flying is about more than just getting off the ground.

The modern aircraft requires millions of lines of software code just for on-board functions such as guidance, navigation and control.

“Even in the most modest projections a fourfold increase in performance will be required for on-board processors in next-generation aircraft. Existing hardware and software platforms may struggle to cope with these new demands.” said Dr. Francisco J. Cazorla, Technical Manager of the PROARTIS (**P**robabilistically **A**nalyzable **R**eal-**T**ime **S**ystems) Project and director of the Operating System/Computer Architecture group at the Barcelona Supercomputing Center

Some of the predicted demands on future platforms include:

- the increased use of automatic dependent surveillance-broadcast (ADS-B) systems, which allow aircraft to determine their own position using a global navigation satellite system and to periodically broadcast this position and other relevant information to potential ground stations and other aircraft equipped with ADS-B;
- “pilot optional” aircraft designed to bridge the gap between UAVs (Unmanned Autonomous Vehicles) and conventional aircraft;
- the demand for diagnostic/prognostic systems that can monitor aircraft components in flight and determine their “health”;
- the need to reduce carbon footprint levels.

Although the microprocessors used in modern aircraft systems might be the same ones that you will find in your PC or laptop, we're not exactly talking about your average home or office-use software here.

Most people can cope with occasional poor performance from their PC software as long as it goes fast most of the time.

In the case of aircraft software, occasional poor performance is unacceptable because of the risks involved. And that's where the problems start.

“Showing that avionics software is always fast enough is an expensive manual process”, said Guillem Bernat, CEO of York-based Rapita Systems, one of the partners of the PROARTIS Project. “More importantly, while this deterministic approach tries to offer absolute guarantees, it can only do so at the expense of performance.”

Using the traditional deterministic approach also means the more complex the software, the more effort is required to verify its effectiveness.

So what's the answer? A consortium of partners - the Barcelona Supercomputing Center (Spain), the University of Padua (Italy), Institut National de Recherche en Informatique et Automatique (France), Rapita Systems (UK), and Airbus France (France), along with associates from the University of Massachusetts Amherst (USA) and the University of York (UK) - think it lies in something called "probabilistic analysis".

If proved, they believe the idea could have revolutionary implications for air travel in decades to come.

PROARTIS will test the feasibility of a paradigm shift to using only probabilistic or random analysis techniques. The research will apply the law of large numbers to predict the behaviour of software code and the amount of time each piece takes to run.

In addition to partners and associates, the project also has an Industrial Advisory Board (IAB) made up of key experts from universities and the Automotive, Space and Microprocessor industries, plus specialists in Real-Time Operating Systems, Compilers and Software tools for critical real-time embedded (CRTE) systems.

The expected results include increased processor performance, greater reliability and reduced overheads in terms of weight, power consumption and size of hardware platforms. Using probabilistic techniques could also speed up system safety and verification checks.

The main difference between what the Wrights and their competitors at the turn of the twentieth century were doing was the brothers were pioneers in flight using a control system.

The rest, it seems, were just happy to stay up in the air for a few seconds or (usually) less before crashing to the ground.

As a result, the Wrights' original concept of simultaneous coordinated "roll and yaw control (rear rudder deflection)" is still in use today on virtually every fixed-wing aircraft.

PROARTIS partners are confident that the PROARTIS work, like that of the Wright brothers, will also stand the test of time.

"The life cycle of deterministic analysis for critical real-time embedded software systems is coming to an end. With better testing and analysis, we're confident the PROARTIS project is another step on the road to meeting the future needs of the avionics industry."

PROARTIS is scheduled to take three years to complete and has a budget of €2,425,654.

Find out more by visiting the project website at [www.proartis-project.eu](http://www.proartis-project.eu).

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