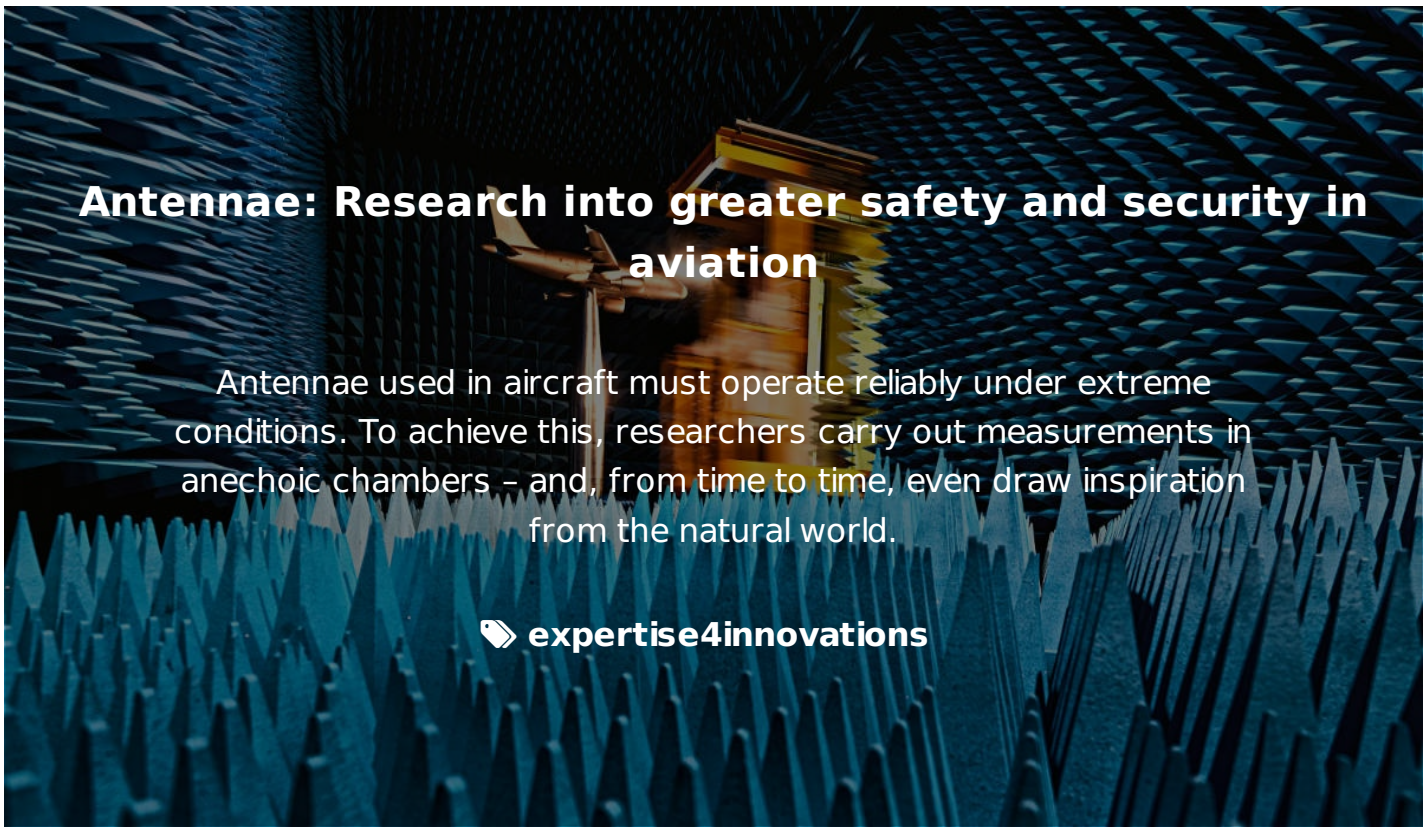


Antennae: Research into greater safety and security in aviation

Antennae used in aircraft must operate reliably under extreme conditions. To achieve this, researchers carry out measurements in anechoic chambers – and, from time to time, even draw inspiration from the natural world.

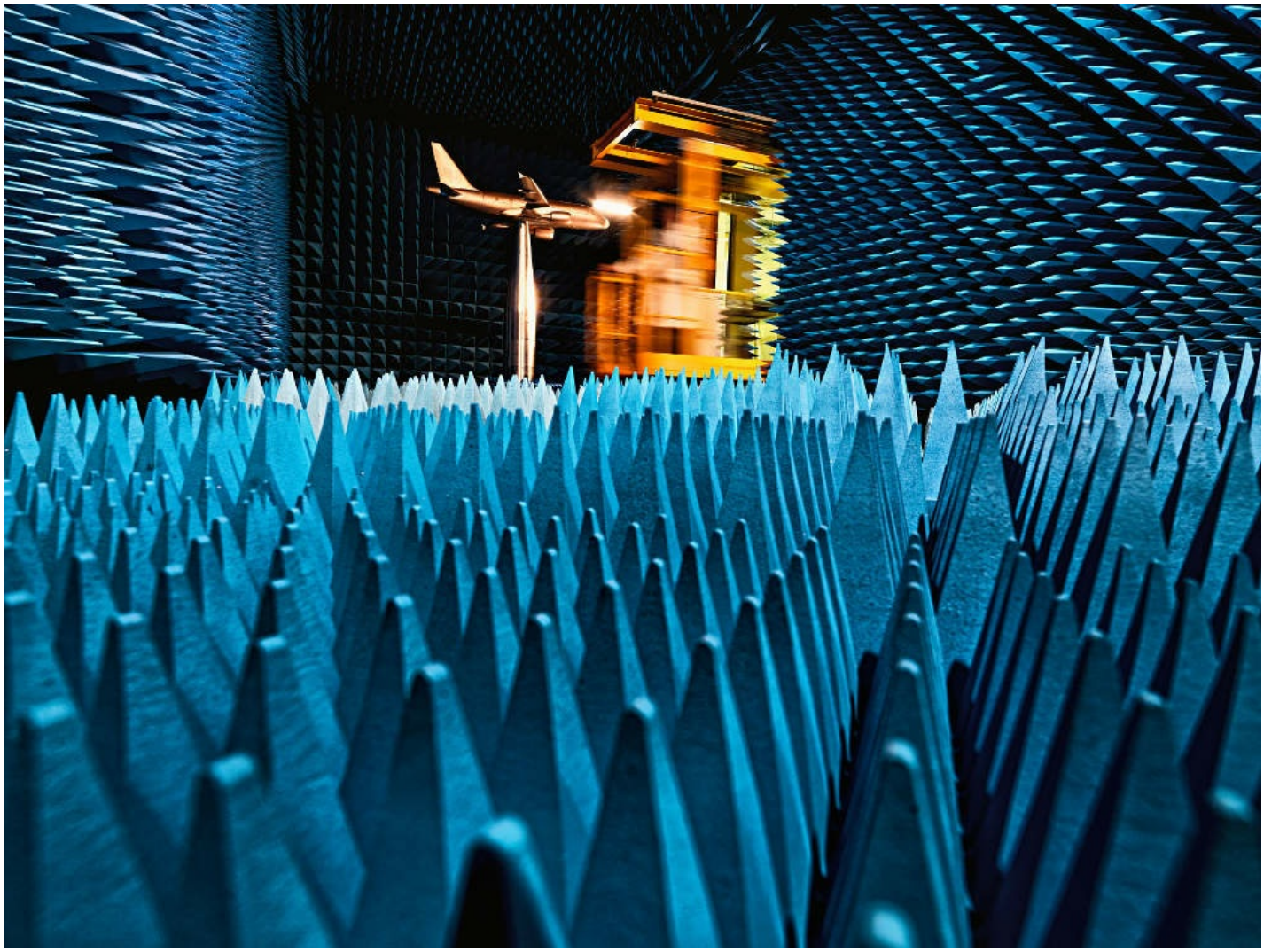
expertise4innovations

© Wolfram Schroll

Without radio waves, nothing on board an aircraft would work: no radio, ground-based or satellite-based navigation systems, weather radar, transponders, collision warning systems, online connections or on-board Wi-Fi. All kinds of data are transferred out of and into the aircraft wirelessly, and in large quantities. This takes place several kilometres above the surface of the earth at speeds that approach the sound barrier and with external temperatures that would endanger life. The requirements placed on antennae to operate reliably and free from electromagnetic interference are correspondingly high — in extreme environmental conditions and at every stage of the flight, including when storms are nearby.

Experimenting with antennae free from environmental influences

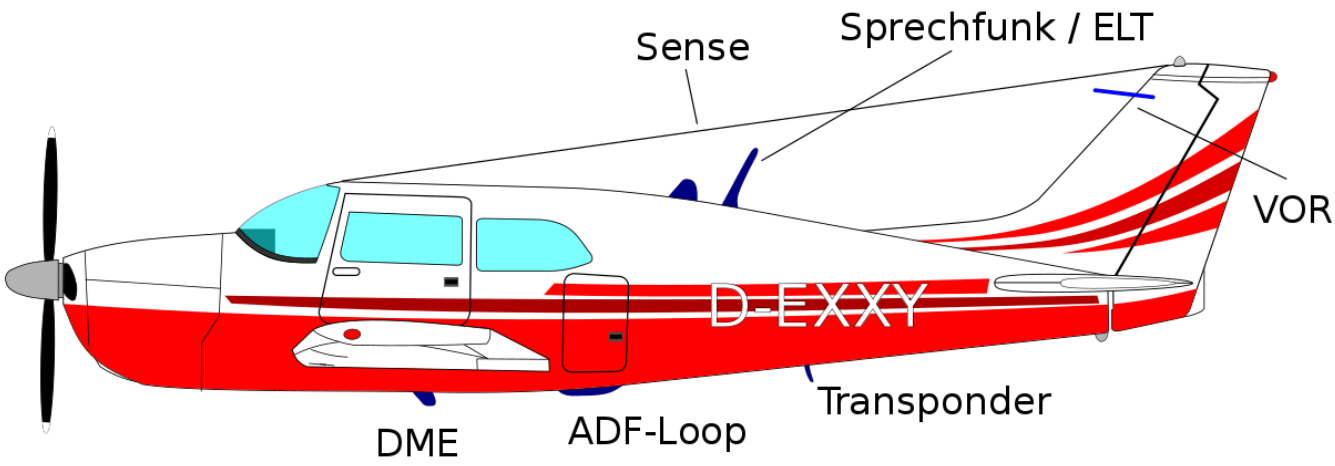
When creating the January page of our ARTS calendar, our photographer, Wolfram Schroll, was given access to somewhere truly special: he was invited into an anechoic chamber where Airbus Group Innovations engineers research different antenna configurations, both in and on aircraft. These rooms are well known for providing a silent space, with the walls being clad in absorptive material to prevent echoing, enabling precise acoustic measurements to take place. Depending on the nature of the absorptive material used, reflections of radio frequency waves can also be prevented, which experts refer to as a “radar anechoic chamber.” Whether sound or radio waves, the chamber simulates a theoretically infinite space that is free from interference.



Antenna experiments are carried out in so-called radar echo chambers - © Wolfram Schroll

Airbus Group Innovations operates as a central research and technology facility within Europe's largest aviation group. Within this context, innovative technologies are developed for Airbus's civilian and military businesses – with antennae being one important aspect of that research.

These anechoic chambers, free from all interference, provide Airbus Group Innovations' engineers with the perfect working environment for simulating the behaviour of materials, structures and antennae in detail. One of their aims is to optimise the positioning and nature of aircraft antennae even further. To this end, a variety of different antenna installations are installed and measured on scale aircraft models. Computer simulations, based on highly advanced algorithms, also form part of their work. Another significant aim is to ensure that there is sufficient protection from interference against electronic devices, while research is also undertaken into radar applications and stealth technology to conceal aircraft from radar.



Even light aircraft feature a number of different antennae for different functions - © Frank Murmann [CC BY-SA 3.0] via Wikimedia Commons

Radar research at the Fraunhofer Institute

Wachtberg, near Bonn, is another centre of research into radio waves. The town is home to the Fraunhofer High Frequency Physics and Radar Institute, FHR – the “radar dome” between Bonn and the Eifel is a striking characteristic of the region. With around 280 employees, the facility is one of Europe’s largest radar research institutes. “The High Frequency Physics and Radar Institute (FHR) develops concepts, processes and systems for electromagnetic sensing, particular in the field of radar, combined with new methods of signal processing and innovative technologies from the microwave to lower terahertz spectrum” Institute on its website.

Mobile phone antennae work differently

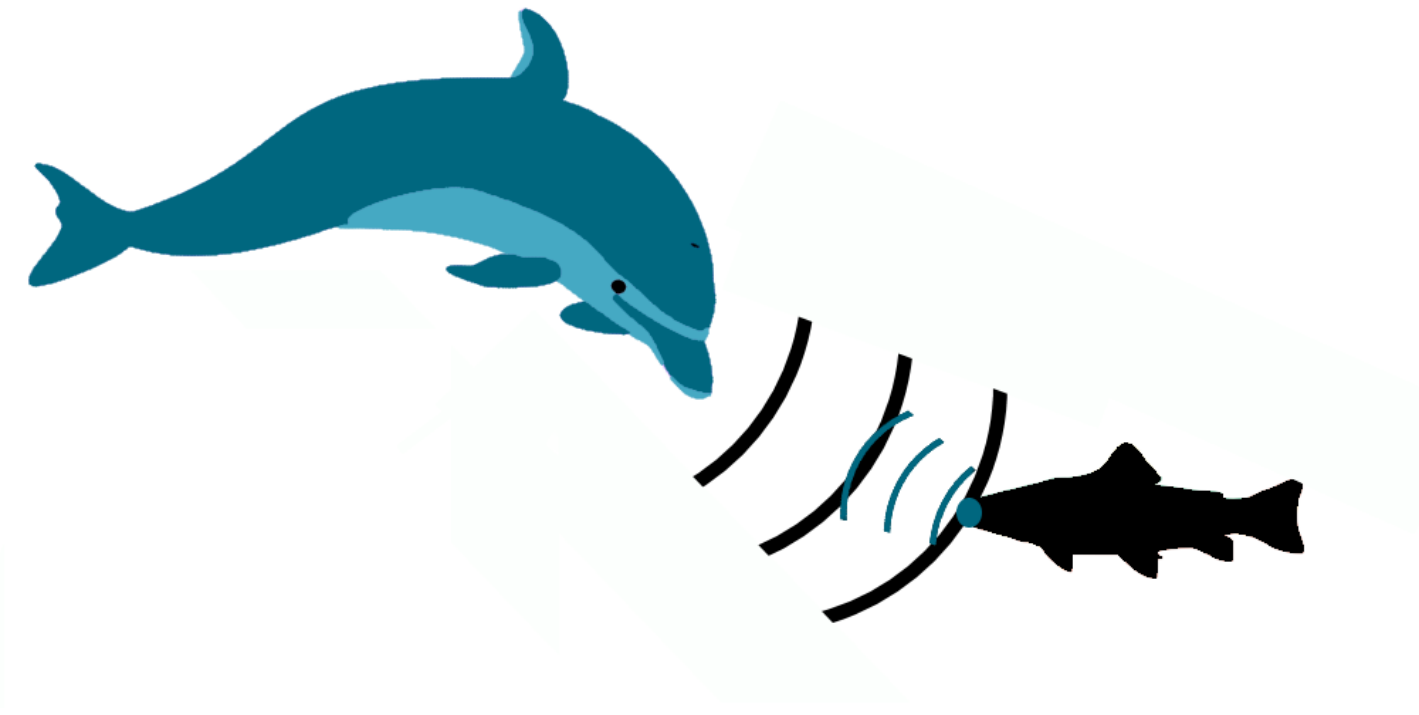
If you take a look beyond the field of aviation, you can find a completely different set of antennae research: so-called reverberation chambers represent the opposite of the echo-free chambers described above. In these chambers, radio waves are deliberately dispersed and reflected to simulate the behaviour of mobile phones under realistic conditions. Lasting waves and interference are expressly desired: the walls are not made from absorptive materials, but from metal. This research is mainly designed to address the particular requirements for mobile phone antennae, which are largely focused on energy efficiency.

A motorbike undergoes testing in a reverberation chamber - © Dr. Hans Georg Krauthäuser [CC BY-SA 3.0] via Wikimedia Commons

Inspired by nature

A glance into the animal kingdom – is extremely relevant, with nature providing a role model for antennae, as is so often the case. Migratory birds use the earth's magnetic field for orientation purposes.

Dolphins make themselves understood and orient themselves under the water by using ultrasound waves that are unaffected by reflections. Some fish species generate electrical impulses to locate themselves. These, and many more technologies, have proven so effective that humanity seeks to imitate them with varying degrees of success. This article from Planet Wissen (Planet Knowledge) provides a worthwhile insight as to how scientists are aiming to learn from nature. The process goes full circle with low-reflection chambers. As mentioned above, these are not only suited for research into antennae and radar systems; they can also be used for acoustic measurements, which is of relevance to noise reduction.



Dolphins use ultrasound waves and their reflections to make themselves understood and to locate themselves with respect to other animals and objects

Noise reduction: a special kind of measurement

Noise reduction is a hot topic in the field of aviation, which we will discuss in greater detail on our September calendar page. What we can say here, however, is that all projections anticipate further growth in aviation over the coming decades. In 2016 alone, the International Air Transport Association (IATA) reported above-average growth in passenger numbers of 6.3 per cent. Even though greater passenger numbers do not necessarily mean an absolute increase in the numbers of take-offs and landings, due to the increased use of wide-body aircraft, the aviation sector strives to reduce noise emissions even further in future. Particularly in densely populated areas, relationships between local residents and their neighbouring airports and general aviation facilities are not always the best.

In commercial aviation, there are a number of different approaches used in the battle to lower noise emissions. A significant contribution is made by engine manufacturers, whose units are constantly becoming quieter and more efficient, while air traffic control works to optimise approach procedures. There are other activities at a local level, such as the soundproofing hall at Zurich Airport that has been introduced at Zurich Airport, allowing engines to be maintained on the ground at full load without disturbing local residents.

General aviation is also heavily engaged in combatting noise. One positive example of silent flight is provided by ultralight aircraft, which are subject to particularly strict limits that must be achieved as part of their type approval. Certified single and twin-engined aircraft also make use of technology to reduce noise effectively, with effective exhaust systems and modernised propellers providing the key to success. Often, although not always, even older designs can be brought up to date in this way. Aircraft that do not meet specifications are punished, at least here in Germany, by restrictions on take-offs and landings and increased fees for doing so. While more and more hybrid and electric aircraft will be flying in the future, the topic of noise might be solved in the not-too-distant future in any event.

Sources: CFK Village | elektroniknet.de | FLUG REVUE | FAZ | Fraunhofer FHR | Planet Wissen | Pratt & Whitney Canada | Wikipedia

Freelance journalist and photographer

Patrick Holland-Moritz, who is himself an active pilot, was employed as aviation editor for the aerokurier magazine for 13 years. He now works as a freelance journalist, supporting businesses in their communications, while photography is both a hobby and a professional activity for him.

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