Environmental Concerns: Noise and Emissions

Reduction of noise and emissions are two main concerns regarding the environment. Noise reduction has been for a long time a major area of activity in acoustics, with significant economic and social implications in many contexts, such as home, workspaces, public domains, transportation systems, and others, both for health and comfort reasons. There is an increasing concern on air quality and its health effects, as well as on environmental pollution and its effects on climate change. As a consequence, the reduction of emissions has gained at least comparable importance to noise reduction. The two aspects can be related, for example in transportation systems, since engines produce both noise and emissions, and the reduction of both may lead to compromises in design. Thus, acousticians concerned with noise reduction may have to consider the effects on emissions in the future. For example, reducing noise by means that increase fuel consumption, will be resisted not only on economic grounds but also because of the increase in emissions. These issues can be illustrated in the case of transportation, in particular air travel, that affects noise near airports and both local and global emissions.

In the case of aircraft, there are worldwide certification standards set by ICAO (International Civil Aviation Organization) with limits on take-off, landing approach, and sideline noise. These limits depend on aircraft weight, and become more stringent with the introduction of new stages, taking advantage of advances in noise reduction technology. Being a United Nations organization, the ICAO noise limits are not compulsory on member states but are followed by national certification authorities in most countries, like the FAA (Federal Aviation Administration) in the United States or the EASA (European Aviation Safety Agency) in the European Union.

Complying with the ICAO noise standards does not mean an aircraft can operate at any airport anywhere in the world; countries, specific regions, and individual airports can impose stricter standards as well as local courts that can rule on the complaints of residents. The noise limits at important airports like Heathrow in the UK, cannot be ignored by aircraft manufacturers, and are indeed complied with by Airbus and Boeing aircraft.

Besides tightening certification noise standards, ICAO has advised on a comprehensive noise reduction strategy, with three elements: (i) noise reduction at the source, that is mainly technology-driven; (ii) optimized operations at the landing approach, on the ground and at take-off, that depends on ATM (Air Traffic Management) and AGM (Airport Ground Movements); (iii) land planning to minimize the noise impact on more densely populated urban areas. In addition to

periodically tightening noise limits, as far as technological progress allows, and advising on comprehensive noise reduction strategies, ICAO is taking an increasing interest in emissions, through CAEP (Committee on Aviation Environmental Protection). After long negotiations, an agreement has been reached on the first emission reduction scheme called CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation), which foresees minimum yearly percentage reductions in emissions relative to the levels of 2019. Initially, the reference period was 2019-2020 but this has been amended to 2019.

Due to the covid-19 pandemic, air travel has reduced by 50% or more this year, with corresponding noise and emission reductions, setting a very low standard that would be impossible to meet in the future when traffic demands return to normal levels. Objectives like carbon-neutral aviation by 2050 will require major advances in propulsion, including hybrid electric, hydrogen propulsion, and synthetic sustainable fuels. These technologies will affect engine design and the noise they produce. A strong focus on CO₂ reduction could also have a negative effect on other emissions like NO_x and also on noise. It is therefore important that the current priority in limiting CO₂ emissions also considers the consequences of other emissions and noise. Situations such as with cars, where diesel vehicles were encouraged to reduce fuel consumption, and then almost banned due to particle emission, should be avoided. A global approach to environmental effects, considering all types of emissions and noise is needed, to have a consistent policy that can be followed in the long term, without reversals.

One final thought: the analog of carbon-neutral aviation would be 'noiseless aviation', meaning that take-off and landing noise, and ground operations at airports, should be below the surrounding noise due to road traffic and other noise sources. It is feasible with current technology to design such aircraft with distributed propulsion, but only with an unacceptable penalty in cruise efficiency, fuel consumption, and global emissions. The long-term enduring challenge is to improve efficiency to reduce fuel consumption, emissions, and costs in cruise flight with low noise and emissions locally near airports. A hydrogen-powered aircraft with distributed electric propulsion may be a future solution.

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