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Assessment of harmful exhaust emissions during aerobatic aircraft flights

The dissertation concerns the emissivity assessment of aviation piston engines in sports aircraft during aerobatic flights. The main thesis of the article: There is a possibility to assess the impact of aerobatic aircraft engines on the environment, and two auxiliary theses. First: There is a possibility to develop a tool to assess the emissivity of aerobatic aircraft engines. Second: The analysis of the operating conditions of internal combustion engines used in aerobatic aircraft will enable the verification of the research test designed to reflect the operating conditions of these engines. The tests were carried out on two models of aerobatic aircrafts equipped with piston engines: Zlin 50LS (engine: Lycoming AEIO-580 B1A) and Extra 330LC (engine: Lycoming-540 L1B5D).

A typical aerobatic system was prepared to carry out the research task. Test flights were performed, during which the throttle position and the engine rotational speed values were recorded. In order to do this, a special "black box" was developed, thanks to which it was possible to make the required measurements. Sports planes do not have any flight data recording devices by default, unlike the F-16 fighter jet. Semtech DS measuring equipment, belonging to the Institute of Internal Combustion Engines and Powertrains, Poznan University of Technology, will be used for further stages of the work. In the preliminary tests, the values of the aircraft engine rotational speeds during the aerobatic flight were presented. Theoretical and computational values of the engine operating parameters were recorded, and the characteristic points were determined, and using this data the ground tests were performed using exhaust emission measurement equipment. An emission test for aerobatic aircraft was also developed at a later stage. The use of an unusual methodology in how such tests are performed may become the basis for the creation of new exhaust emissions regulations for aircraft with piston engines, which would help in the accurate assessment of the environmental threat they pose. Nowadays, it is only possible to perform a stationary test, due to the maximum allowable weight of the aerobatic aircraft's payload for take-off and the necessary space in the cabin not being sufficient to carry the necessary measuring equipment. Information on emissions would undoubtedly be helpful in reducing the impact of exhaust emissions on the environmental pollution level. In the future, this could enable optimization of piston engines operation, and thus reduce the resulting exhaust emissions.

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