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Simulation Research of Innovative Ignition System of ASz62IR Radial Aircraft Engine

Authors : Miroslaw Wendeker, Piotr Kacejko, Mariusz Duk, Pawel Karpinski

Abstract : The research in the field of aircraft internal combustion engines is currently driven by the needs of decreasing fuel consumption and CO2 emissions, while fulfilling the level of safety. Currently, reciprocating aircraft engines are found in sports, emergency, agricultural and recreation aviation. Technically, they are most at a pre-war knowledge of the theory of operation, design and manufacturing technology, especially if compared to that high level of development of automotive engines. Typically, these engines are driven by carburetors of a quite primitive construction. At present, due to environmental requirements and dealing with a climate change, it is beneficial to develop aircraft piston engines and adopt the achievements of automotive engineering such as computer-controlled low-pressure injection, electronic ignition control and biofuels. The paper describes simulation research of the innovative power and control systems for the aircraft radial engine of high power. Installing an electronic ignition system in the radial aircraft engine is a fundamental innovative idea of this solution. Consequently, the required level of safety and better functionality as compared to the today's plug system can be guaranteed. In this framework, this research work focuses on describing a methodology for optimizing the electronically controlled ignition system. This attempt can reduce emissions of toxic compounds as a result of lowered fuel consumption, optimized combustion and engine capability of efficient combustion of ecological fuels. New, redundant elements of the control system can improve the safety of aircraft. Consequently, the required level of safety and better functionality as compared to the today's plug system can be guaranteed. The simulation research aimed to determine the vulnerability of the values measured (they were planned as the quantities measured by the measurement systems) to determining the optimal ignition angle (the angle of maximum torque at a given operating point). The described results covered: a) research in steady states; b) velocity ranging from 1500 to 2200 rpm (every 100 rpm); c) loading ranging from propeller power to maximum power; d) altitude ranging according to the International Standard Atmosphere from 0 to 8000 m (every 1000 m); e) fuel: automotive gasoline ES95. The three models of different types of ignition coil (different energy discharge) were studied. The analysis aimed at the optimization of the design of the innovative ignition system for an aircraft engine. The optimization involved: a) the optimization of the measurement systems; b) the optimization of actuator systems. The studies enabled the research on the vulnerability of the signals to the control of the ignition timing. Accordingly, the number and type of sensors were determined for the ignition system to achieve its optimal performance. The results confirmed the limited benefits, in terms of fuel consumption. Thus, including spark management in the optimization is mandatory to significantly decrease the fuel consumption. This work has been financed by the Polish National Centre for Research and Development, INNOLOT, under Grant Agreement No. INNOLOT/I/1/NCBR/2013.

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