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A Dual Spark Ignition Timing Influence for the High Power Aircraft Radial Engine Using a CFD Transient Modeling

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Abstract : A high power radial reciprocating engine is characterized by a large displacement volume of a combustion chamber. Choosing the right moment for ignition is important for a high performance or high reliability and ignition certainty. This work shows methods of simulating ignition process and its impact on engine parameters. For given conditions a flame speed is limited when a deflagration combustion takes place. Therefore, a larger length scale of the combustion chamber compared to a standard size automotive engine makes combustion take longer time to propagate. In order to speed up the mixture burn-up time the second spark is introduced. The transient Computational Fluid Dynamics model capable of simulating multicycle engine processes was developed. The CFD model consists of ECFM-3Z combustion and species transport models. A relative ignition timing difference for the both spark sources is constant. The temperature distribution on engine walls was calculated in the separate conjugate heat transfer simulation. The in-cylinder pressure validation was performed for take-off power flight conditions. The influence of ignition timing on parameters like in-cylinder temperature or rate of heat release was analyzed. The most advantageous spark timing for the highest power output was chosen. The conditions around the spark plug locations for the pre-ignition period were analyzed. 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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