CFD simulation of piston engine nacelle cooling on pusher configuration aircraft

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In recent years a development of new, more reliable tools for multiphysics calculations allowed the designers to address more problems at the very beginning or at early stages of the design process. Such a multiphysics problem is a cooling of the pusher configuration piston engine with air, when the engine is in front of the propeller, and it has to be there because of the airframe design. Of course there is no problem when the aircraft is moving, but during the engine start-up, taxiing or after landing, usually that type of engine is not covered neither with the external flow, nor the propeller wake. Such wake ends up shortly in front of the propeller on its suction side. So, in order to cool down such an engine, an additional source of energy or properly placed cooling outlets, nearly facing the blades, are needed. In order to solve that design issue, which appeared in very light airplane designed in Military University of Technology, a specialized software package, which allow to solve both fluid flow and heat transmission problems, was used. The internal - external flow problem and its problematic boundaries have been avoided by solving both problems at once, using mesh, which had a different density inside and outside the nacelle. Very detailed geometry of the engine and its equipment including the truss mount structure has been modeled. The heat transfer for a few configurations of cooling arrangement has been calculated. The detailed results necessary in the design process of the efficient air cooling system for piston engine in pusher configuration have been obtained. Results presented in this paper will be certainly helpful for all researchers dealing with engine cooling problems in this specific aircraft configuration.