

Kinematics and Dynamics Analysis of Crank-Piston System of a High-Power, Nine-Cylinder Aircraft Engine

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Abstract : The kinematics and dynamics analysis of crank-piston system of aircraft engine. The object of the study was the high power aircraft engine ASz 62-IR. This engine is produced by a Polish company WSK "PZL-KALISZ" S.A.". All analyzes were performed numerically using CAD and CAE environment. Three-dimensional model of the crank-piston system was developed based on real engine located in the Laboratory of Centre of Innovation and Advanced Technologies of Lublin University of Technology. During the development of the model, the technique of reverse engineering - 3D scanning was used. ASz 62-IR engine is characterized by a radial type of crank-piston system. In this system the cylinders are arranged radially around the circle. This crank-piston system consists of a main connecting rod and eight additional connecting rods. In addition, three-dimensional model consists of a piston pins, pistons and piston rings. As a result of the specific engine design, characteristics of the piston individual movement are slightly different from each other. But the model assumes that they are the same during the analysis. Three-dimensional model of the engine was implemented into the MSC Adams software. The environment of MSC Adams allows for multibody simulation of the dynamic phenomena. This determines the state parameters of the moving elements, among which the load or force distribution on each kinematic node can be distinguished. Materials and characteristic materials parameters were adopted on the basis of commonly used materials for engine parts. The mass values of individual elements were adopted on the basis of real engine parts. The piston gas forces were replaced by calculation of pressure variations recorded during engine tests on the engine test bench. The research the changes of forces acting in the individual kinematic pairs of crank-piston system. The model allows to determine the load on the crankshaft main bearings. This gives the possibility for the main supports forces analysis The model allows for testing and simulation of kinematics and dynamics of a radial aircraft engine. This is the first stage of the work, which aims to numerical simulation of vibration of multi-cylinder aircraft engine. This work has been financed by the Polish National Centre for Research and Development, INNOLOT, under Grant Agreement No. INNOLOT/I/1/NCBR/2013.

Keywords : aircraft engine, CAD, CAE, dynamics, kinematics, MSC Adams, numerical simulation

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