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Title

Helicopter main rotor blade structure parametric optimization using graphic programming language

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Abstract

The Russian assault on Ukraine revised the possible operations that can be conducted by helicopters on modern battlefield. The necessity of constructions that are able to provide better characteristics for widespread military operations is noted more than in any other conflict in XXI's century. As a result, a lot of countries are enhancing current configurations and searching for brand new solutions of VTOL vehicles. Therefore, there is a need for providing a tools that will give an options for rapid preparing and checking new solutions in helicopter design loop.

This work presents the method of preliminary structure optimization of main rotor blade using parametric modelling. It is a next step in main rotor optimization studies. It is next step after the preparing the parametric model for the external shape CFD analysis. As a basis for parametric blade structure calculations the analytical model is provided in this paper. The equations of rigid blade loads and as a consequence of the strength elements stresses are shown.

The parametric blade modelling is conducted using GRIP (Graphic Integrated Programming) language. The parametric design method is shown to be used for various blade planform models and different section airfoils. The structure of blade is generated automatically after entering the parameters by user. The code inbuilt analysis systems provides a quick inertia examination of the generated geometry, which are the bath for further optimization. Program is calculating the blade loads and verify it with given materials conditions and proposed safety factor. In the analysis the composite materials for the strength elements were proposed. The code works as an loop, where at the end the generated geometry is a proposal of structure with optimal dimensions for the possible lowest mass. In this paper it is also presented the possibility of implementing the ready geometry into structure MES analysis software for further comprehensive analysis.

As an output of the study, the alternatives for main rotor optimization are developed. The usage of parametric modelling for different shapes and working conditions is shown in the work as a new view for the main rotor design optimization.

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