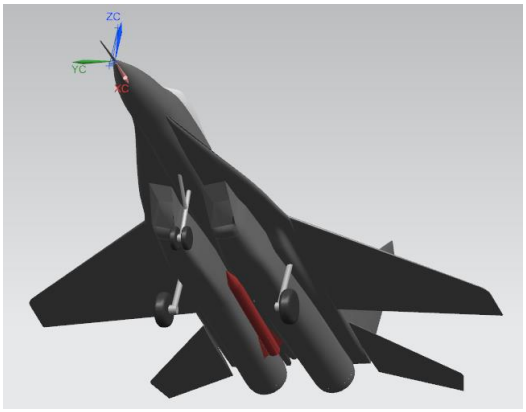
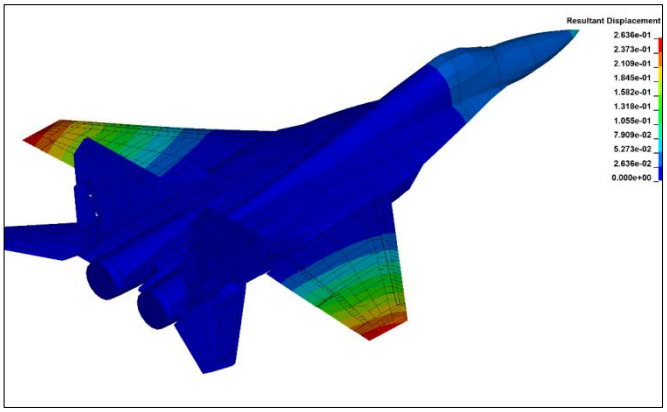
Finite Element Analysis of the Suspended Satellite Rocket Weight Effect on the Strength and Deformability of the MiG-29 Aircraft Structure

Aleksander Olejnik[1)], Piotr Zalewski[1)], Robert Rogólski[1)], Michał Jędrak[1)], Michał Szcześniak[1)]

[1)]Military University of Technology – Faculty of Mechatronics, Armament and Aerospace

The paper presents selected aspect of the research project entitled: *Airborne-and-missile system of delivering satellite payloads to low Earth orbit - feasibility study*. The aim of the project is to conduct series of aerodynamic, aeroelastic and strength simulation of Polish aging combat aircraft (Mig-29 and Su-22) to assess the possibility of using one of them as an airborne platform for carrying a rocket with a detachable satellite payload. This work presents airframe load and strength analysis of the airframe of MiG-29 for assumed operational variants with carrying rocket under-fuselage suspension. The numerical simulations were conducted on the structural discrete model of the aircraft prepared for finite element analysis in MSC Patran. Model development involved such aspects as precise discretization of geometric model, declaration of material constants, identification of structural properties, introduction suitable merging connections for included airframe assemblies, final model weight and stiffness validation. The model was analysed in MSC Nastran and LS Dyna software. For the purposes of the calculations, the IMPLICIT analysis type was selected in the field of linear statics. The flight loads introduced into the model were calculated for specific points of the flight envelope - the highest values of load factor were taken into consideration (n=9). The counterpart aerodynamic force distribution in a form of a set of equivalent lumped forces was calculated. Then the aerodynamic forces were added using the forces applied to the wing at the model nodes along the span. A gravitational load with an appropriate overload factor was simulated also. Rocket masses were taken into account by concentrated forces applied on the attachment of the suspension frames. Calculations were made for rockets of several weight values between 800 and 1500 kg. Parametric dependencies were investigated of the impact of rocket weight and size on the stress distribution over the whole structure. The areas of stress cumulations and were identified. Apart of that the modes of static structural deformation were simulated which allowed to assess maximum wing tip displacements during the flight in ultimate conditions.


ZC
YC
XC


Resultant Displacement
2.636e-01
2.373e-01
2.109e-01
1.845e-01
1.582e-01
1.318e-01
1.055e-01
7.909e-02
5.273e-02
2.636e-02
0.000e+00