Absolute Cross-Section of Turbojet Aviation Engine Calculation

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Abstract - **The calculation method of three-dimensional model of turbojet aviation engine is offered, thus the form of turbine vanes with spiralling is described like parametric surface. The method allows make the calculation of absolute cross-section (ACS) of turbojet aviation engines with different geometrical parameters. The calculation results of ACS of aviation engine are presented.**

Keywords - **Turbojet aviation engine, Absolute cross-section.**

I. Introduction

Study of the characteristics of airplane engines secondary radiation is of great interest, as the engine unit makes the significant influence on ACS of air targets [1]. Moreover, study of the turbine modulation event is essential for the solution of air targets recognition problem.

II. Model Description and Results

Both turbojet and turbofan engines have protective jackets. Observation of the first level of aviation engine is possible at rather small deviation of observation axis from the geometric engine axis. Therefore, the physical optics (PO) method is suitable for the development of the mathematic method of.

The form of turbine vane may be described rather accurately with the help of the ordinary helicoid equation, which is expanded as [2]:

$$\begin{cases} x = v\cos(u) \\ y = v\sin(u) \\ z = lu + h \end{cases} \quad (1)$$

Geometric size of the vane may be defined by the following parameters: height proportion factor l, twist angle (angle between the lower and upper vane edges) parameter u, widths of vane base and end parameter v, where h characterizes the distance of the vane base from the center of compressor axial symmetry.

Values Eq.(1) for the rest of vanes of the batch may be found easily and with no excess calculation inputs by means of subsequent turning of the coordinate axes for the angle of 360/n, where n – vane number in the batch.

Set the rest of turbojet engine elements with the help of outer cylinder and inner cylinder, connected to the turning paraboloid.

Geometry of turbojet aviation engine MODEL is presented on Fig. 1

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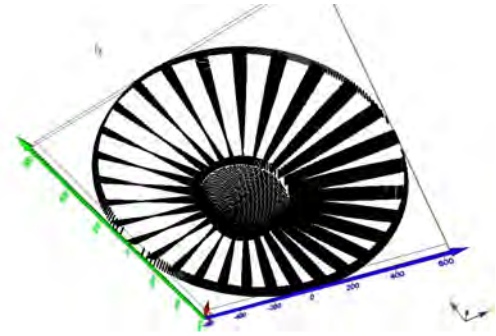

Fig.1 Geometry of turbojet aviation engine model

ACS calculation is carried out with the help of physical optics (PO) method. The expression for ACS at PO approximation will be:

$$\sigma_S = \frac{4\pi}{\lambda}\left|\int_{S_{rad}} e^{-2jk_0\left(\vec{R}^0\cdot\vec{x}\right)}\left(\vec{n}\cdot\vec{R}^0\right)dS\right|^2, \quad (2)$$

where: k_0 – wavenumber; λ – wavelength; $\vec{x}$ – radius-vector of observation point; $\vec{R}_0$ – unit vector of irradiation direction; $\vec{n}$ – turbine surface normal.

On fig.2 calculation results of ACS alteration during turbine rotation is presented.

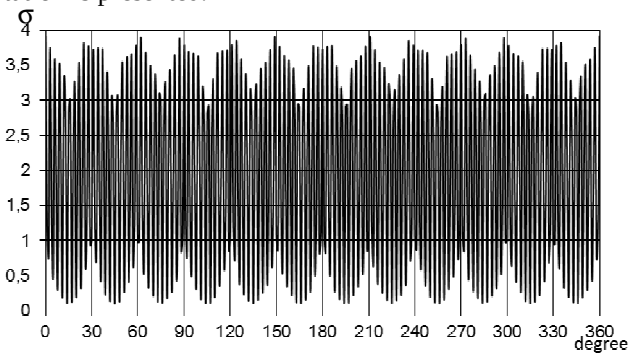

Fig.2 Modeling results for observation point position x=200, y=100, z=0

III. Conclusion

In this paper calculation method of three-dimensional model of turbojet aviation engine is described. Calculation results of ACS of turbojet aviation engine model is presented.

References

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