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RESEARCH OF THE TRANSPARENCY CHARACTERISTICS OF THE ATMOSPHERE WHICH INFLUENCE THE FLIGHT CONTROL OF FLYING MACHINES

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ABSTRACT: *A detailed optical research is carried about to examine the transparency characteristics out of the atmosphere which influence the flight control of self-moving and self-indicating flying machines. Methods for determining the atmosphere transparency coefficient for monochrome and compound radiation are proposed. The water vapours quantity in horizontal and vertical direction is calculated. Methods for determining the mass of the air and the carbon gas in horizontal, included and vertical direction are proposed.*

KEY WORDS: *Cisco, Atmosphere, Characteristics, Transparency.*

1. Introduction

In the process of developing of optical and opto-electronic equipment for the need of the space physics and distance research methods of particular concern is the atmosphere transparency that influences the visibility distance of distant objects and also influences the flight control of flying machine [1, 5, 6, 7].

By dissemination through the atmosphere the stream radiation is weakened as at the expense of molecular dispersion [2] and by its absorption of the different components of the atmosphere [3]. Because the stream weakens selectively then the atmosphere transparency can be determined for monochrome radiation [4].

As the main factors that influence the weakening of stream radiation in the atmosphere are known then the following formula for calculation of spectral atmosphere transparency it can be written:

$$(1) \qquad \tau_{\alpha}(\lambda) = \prod_{i=1}^{n} \tau_{pi}(\lambda) \prod_{j=1}^{k} \tau_{ni}(\lambda) = \tau_{p1}(\lambda)\tau_{p2}(\lambda)\tau_{nH_2O}\tau_n(\lambda)_{CO_2}\tau_n(\lambda)_{O_3}$$

where $\tau_{p1}(\lambda)$ and $\tau_{p2}(\lambda)$ – coefficients for skipping through the atmosphere of monochrome radiation stream by taking into account the weakening at the expense of the molecular dispersion ($\tau_{p1}(\lambda)$) and aerosol dispersion ($\tau_{p2}(\lambda)$).

$\tau_{nH_2O}\tau_n(\lambda)_{CO_2}$ $and\ \tau_n(\lambda)_{O_3}$ – coefficients for skipping through the atmosphere of monochrome stream by taking into account the weakening only at the expense of the water vapours, carbon gas and ozone absorption.

The value of the coefficient $\tau_{p1}(\lambda)$ determining by relay dispersion of the molecules of the gases with the following formula is calculated:

$$(2) \qquad \tau_{p1}(\lambda) = e^{-\alpha_{p1}(\lambda)L},$$

where

$(3) \qquad \alpha_{p1}(\lambda) = \frac{32\pi^3(n^2-1)^2}{3N\lambda^4},$ - coefficient for weakening at the expense of molecular dispersion;

$N = 2{,}9.10^{19}$ l/cm - air density at normal pressure, expressing the amount of particles in one cubic;

n=1,0003 - indicator of refraction of air;

L - distance between transmitter and receiver.

After solving formulas (2) and (3) it can be noted that visible part of the molecular dispersion spectrum is sufficiently high and that significantly influences on the reduction of the transparency due to which need to be considered by calculation the flight control of the flying machines.

The skipping coefficient $\tau_{p2}(\lambda)$ that gives an account of loses of the aerosol dispersion can be calculated by a formula similar to (2):

$$\tau_{p2}(\lambda) = e^{-\alpha_{p2}(\lambda)L}. \quad (4)$$

For the calculation of the coefficient value $\alpha_{p2}(\lambda)$ is required some knowledge of the quantity, size and composition of the substance aerosol particles, which cause scattering of the radiation. This creates great difficulties and practically precludes the implementation of an analytical method for determining the skipping coefficient $\tau_{p2}(\lambda)$.

The most accessible method for determining the skipping coefficient $\tau_p(\lambda) = \tau_{p1}(\lambda)\tau_{p2}(\lambda)$ by taking into account of summarized radiation weakening at the expense of the molecular dispersion and aerosol dispersion is based on the data of metrological distance visibility $L_{\text{visibility}}$.

Between $\tau_p(\lambda)$ and metrological distance visibility $L_{\text{visibility}}$ exists particular relationship related to the infrared part of optical spectrum. The coefficient values of $\tau_p(\lambda)$ depending on $L_{\text{visibility}}$ are brought on fig. 1. The presented graphics are created when the distance L' between the object and receiver is 2 km.

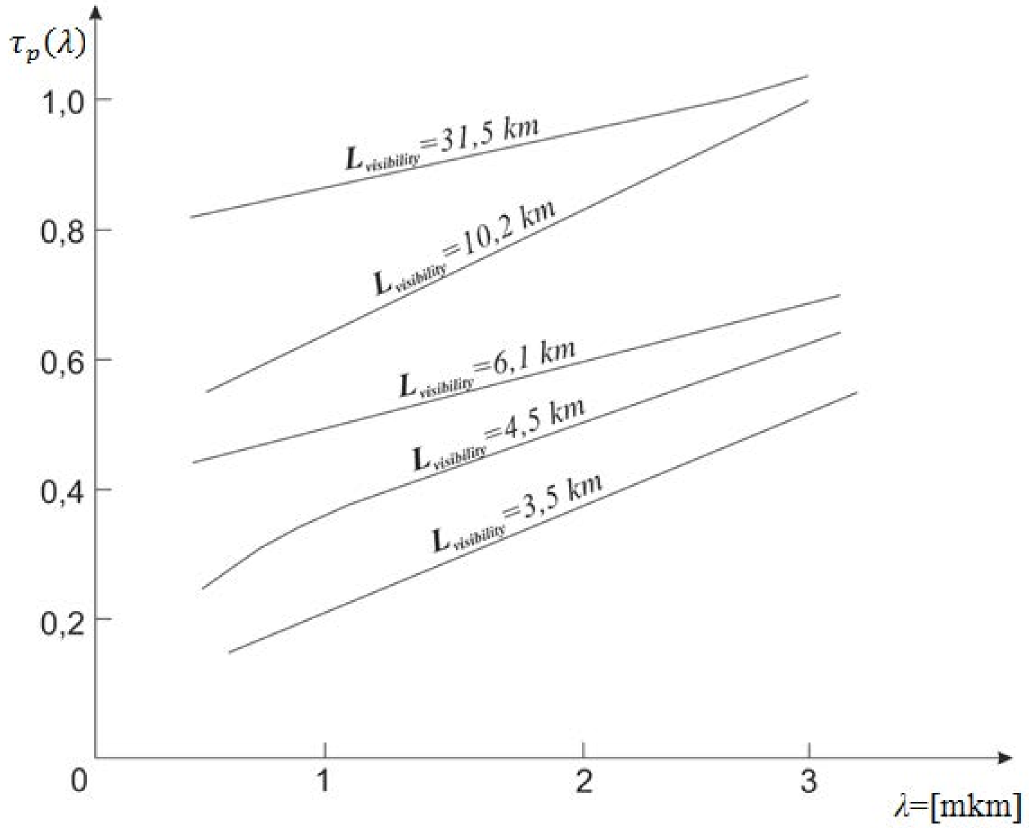

Fig.1. Modification of the coefficient $\tau_p(\lambda)$ depending on the metrological distance visibility

If the real distance L differs from L' then the value of skipping coefficient $\tau_p(\lambda)$ is determining by calculating on the base of Buger's law.

$$\tau_p(\lambda) = [\tau_{p2}(\lambda)]^L = [\tau'_{p2}(\lambda)^{\frac{1}{2}}]^L = [\tau'_p(\lambda)]^{\frac{1}{2}}, \tag{5}$$

where

$\tau_p(\lambda)$ – skipping coefficients of the atmosphere of monochrome radiation stream through atmosphere layer with thickness L, km;

$\tau_{p1}(\lambda)$ – skipping coefficients of monochrome radiation stream through an atmosphere per unit thickness;

$\tau'_p(\lambda)$ – taken out of the graphic reference value of the skipping coefficient of monochrome radiation stream.

By using the formula can be determined the atmosphere skipping monochrome radiation stream with wavelength λ = 1,25 *mkm* by metrological distance visibility $L_{\text{visibility}}$ = 10,2 *km* when the distance between the transmitter and receiver L=5,5 *km*.

For the achieving of wave λ = 1,25 *mkm* by $L_{\text{visibility}}$ = 10,2 *km* with the help of fig. 1. is determined $\tau_p(\lambda)$ = 0,6. After that by using the Buger's law is determined the skipping coefficient $\tau_{p1}(\lambda)$ at L = 1 *km*:

$$\tau_{p1}(\lambda) = \tau'_p(\lambda = 1{,}25mkm)^{\frac{1}{1{,}85}} = 0{,}6^{\frac{1}{1{,}85}}.$$

As far as

$$\tau_p(\lambda) = [\tau_{p1}(\lambda)]^L = [\tau'_p(\lambda)^{\frac{1}{2}}]^{\frac{L}{1{,}85}},$$

then by L= 5,5 *km* we obtain

$$\tau_p(\lambda) = 0{,}6^{\frac{5{,}5}{1{,}85}} = 0{,}216.$$

For the skipping coefficient value of the atmosphere over radiation stream influence the quantity water vapours on the way of radiation spreading. If in real conditions the thickness of water vapours w differs from w' = 17 *mm* by which the graphic on figure 1 is built, then this difference by means of special multiplier is taken into account

$$\tau_{pH_2O} = 0{,}998^{-(w'w)} = 0{,}998^{-(17-w)}.$$

Thereby, the formula for transition from coefficient $\tau'(\lambda)$ which is taken from the graphic of figure 1 the real coefficient $\tau_p(\lambda)$ the following type will acquire

$$\tau_p(\lambda) = [\tau_p^{'}(\lambda)]^{\frac{L}{1,85}} 0{,}998^{-(17-w)}.$$

In conclusion it may be noted the skipping coefficients of the atmosphere of monochrome stream by taking into the account the weakening the radiation, caused by absorption of water vapours τ_{pH_2O} and carbon gas $\tau_n(\lambda)_{CO_2}$ can be determined for different working wavelengths, because they have an especially influence over the flight control of the flying machines.

When considering the characteristics of atmosphere transparency is needed information for the effective layer thickness of water vapours on the way of radiation stream spreading and the carried out ground layer of the thickness of air layer.

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