

MODELING OF ACTIONS OF UNMANNED AIRCRAFT REMOTE PILOT

Both transfer function modeling of actions of unmanned aircraft remote pilot and results of test flights are proposed.

Remote pilot's actions of unmanned aircraft in radio controlled mode can be considered as linear closed loop "remote pilot – control and monitoring line – unmanned aircraft". For model of remote pilot on unmanned aircraft an output parameter is a deviation of moving parameter ΔX_i from predetermined value and an input parameter is a deviation of control stick of transmitter $\Delta \Pi$ using to eliminate the mentioned ΔX_i . This action can be described by transfer function $W(\Pi)$. In general form it can be described by two co-factors:

$$W_n(\Pi) = W_1(\Pi) \cdot W_2(\Pi),$$

where $W_1(\Pi)$ is a property of human motility. These parameters are not controlled by the remote pilot, but are in unconscious state. $W_1(\Pi)$ can be expressed as:

$$W_1(\Pi) = \frac{e^{-\tau \Pi}}{T_{N\Pi^{n+1}}},$$

where τ is a response speed of the remote pilot, $T_{N\Pi^{n+1}}$ is a time constant characterizing the delay of motility responses ($T_{N\Pi^{n+1}} \approx 0,05 \dots 0,1$ sec). $W_2(\Pi)$ represents a property of the remote pilot as self organizing system. At that the system "remote pilot – control and monitoring line – unmanned aircraft" should remain stable. This notion can be represented as:

$$W_2(\Pi) = K_n \frac{T_{1\Pi} + 1}{\Pi(T_{2\Pi} + 1)},$$

where T_1, T_2 are time constants of outpace and time of motility reactions (0,1 ... 3 sec); constant of time of motility reactions (0,5 ... 2 sec).

In test flights it was determined the dependence of vertical velocity of unmanned aircraft from control stick displacement $\Delta \Pi$. It was experimentally determined, that at about half of joystick motion a vertical speed is within 1 m/s, which is enough to keep stable horizontal flight. This take place within the deviations of the control stick in the limits of approximately 12...15 mm, what is fully met the modern standards of the radio control systems.