ABSTRACT

The work concerns research related to dynamics modelling and guiding process an Unmanned Multi-Rotor Aircraft (UMRA). In the course of the work the dynamic features of UMRA were identified. For this purpose, a physical and mathematical model of a multi-rotor object were developed. The UMRA is designed for direct, impact attack of static and moving air and ground targets. Based on the developed models the original simulation program was created. The simulation required the development of a Video Tracking System (VTS) model whose task is to analyse the image from a daylight or infrared camera. The VTS apart from optical sensors includes a computer responsible for target detection and tracking. Output data from the VTS in the form of a deviation measured in pixels, were used by control and guidance systems. It was assumed that UMRA from the moment of indicating the target performs the attack in automatic mode. This required the development of original solutions regarding control laws which include stabilization and navigation algorithms based on PID controllers and a state observer with the Extended Kalman Filter (EKF). In addition, due to the specificity of a multi-rotor aircraft flight, missile guidance methods required a deep modification which led to the development of 8 different original UMRA guidance methods. While implementing this part of the work the 15 guidance methods were tested in the simulation model. All methods have been thoroughly tested. This allowed the selection of the most effective guidance method depending on the type of target, which will ensure a direct hit of the target (circle with a radius of 1m). A large part of simulation research was carried out in the "feedback loop" with real-flight tests.

The result of the work: reliable control algorithms, UMRA self-guiding methods, a flexible simulation model and the VTS model were designed. They allow further development and testing of other multi-rotor facilities.

All developed algorithms will be implemented on real objects that can be used by the Polish Armed Forces.

Key words: Unmanned Multi-Rotor Aircraft (UMRA), simulation model, mathematical model, Video Tracking System (VTS) model, Extended Kalman Filter (EKF), guidance methods.