Information Technology of the Aerial Photo Materials Spatial Overlay on the Raster Maps

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EXECUTIVE SUMMARY

The information technology that is researched in the chapter provides a spatial overlay of the images received by the camera of an unmanned aerial vehicle (UAV) and raster maps of open aerial photography services. Such software helps to solve issues of actualization of maps, observation of agricultural field yields, creation of terrain photo planes, monitoring, etc. "Frames and a Map Overlay Tools" is software developed in C# using .NET4.0. All algorithms that were used during the development of the complex are described in detail, as well as the flow diagrams of the data utilities from which the complex is composed. Despite the fact that the testing of this complex has shown poorly high speed in real time, the estimates will allow the possibility of its interactive use under conditions of further refinement.

INTRODUCTION

Every day processing of photographic materials practically has become necessary for the development of modern technical means for making pictures and monitoring with the help of UAVs. Some common tasks should be solved in different fields of usage. In particular, to overlay photos to the map of the area, the input data should be led to the same scale and transformed using angles of the camera's inclination. There are several methods to make such transformations.

There are many computer programs which allow users to overlay an image on a map (Google Earth; Digitals; MapTiler and etc). They are complex, multifunctional and some of them are expensive. For example, MapTiler which has many functions (one of them is an overlay of image over a map) costs $3500 and its support has to be paid in $200/hour. Integration of such big and complex software as a part of an end product development is time- and resource- consuming process. It is hard to remove some less usable functions from ready-made software. These costs are not reasonable in most cases.

In this section authors defined an information technology which is based on a simple algorithm, easy integrable and not overloaded by additional functionality. It helps to solve problems of the actualization of the maps, the observation of yields of agricultural fields, the aerial photography of pipelines, the monitoring of the status of waste heaps and the creation of photographic planes of the area, for example, see Karpov, 2012; Zheltov, Veremeenko, Kim, Kozorez & Krasilshchikov, 2009 and Nechausov & Zamirec, 2005.

REVIEW OF PREVIOUS LITERATURE

Modern technologies allow creating software for the photo spatial overlays on a map not for professional cartographers only, but also for the amateurs having even slite skills in programming. There are many blogs where the authors describe such own software or guides for professional software using any types of images (from digital cameras, phone cameras and etc.) and various types of maps. But most of them use GPS-based coordinates as input data to tie map with aggregated images (Monastyrskyi, 2017; Khramov, 2016; Google maps overlay; Cleveret, 2016; Adding a Google Earth overlay; Polymaps. Image overlay; Edwards & Titchenal, 2009; Overlay tiled images on a map).

In (Chyrkov & Prystavka, 2018) authors formulated the problem of the aerial photo materials spatial overlay on raster maps as an important component of the successful solution of suspicious objects location on the video stream from the UAV's camera.

It is necessary to add that many of such technologies have a special purpose (military, reconnaissance and etc.) and secret.

STATEMENT OF THE PROBLEM

Let consider the World Geodetic System 84 (WGS 84). The authors assume that UAV is defined by $(B_{BLA}, L_{BLA}, z_{BLA})$ on WGS 84, where B_{BLA} is the camera latitude, L_{BLA} - is the camera longitude and z_{BLA} - is the height of the camera's focus above the surface of the global ellipsoid and coordinates of the UAV's camera are the same as UAV coordinates.

There is also the $\xi\eta\zeta$ O' coordinate system, such that the point O' is a center of the vehicle mass and $\xi\eta\zeta$ are three principal axes, that describe a local position of UAV. The axis ξ is oriented from the vehicle tail to the vehicle nose according to the vehicle course, η is an axis directed from the left to right with regard to the pilot and it is parallel to wings and ζ is an axis directed from a top to a down and it's orthogonal to other axes. Let remark that $\xi\eta\zeta$ O' is the right-hand system.

The following angles are known: ω is the rotation angle of UAV around an axis ξ, φ is the rotation angle around η and κ is the rotation angle around ζ. These angles are called orientation angles of UAV.

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