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COMPONENTS OF INFORMATION TECHNOLOGY PROCESSING OF DATA OBTAINED FROM UNMANNED AERIAL VEHICLE

The system of automated processing and analysis of digital images and videos obtained from the board of unmanned aerial vehicle offered.

Department of Applied Mathematics, National Aviation University offers the system of automated processing and analysis of digital images and videos obtained from the board of unmanned aerial vehicle. This system is fully developed by the department staff in conjunction with the design office "Virage", which is also a division of the National Aviation University. Next, in Figure 1 is shown the scheme with the basic building blocks of the system.

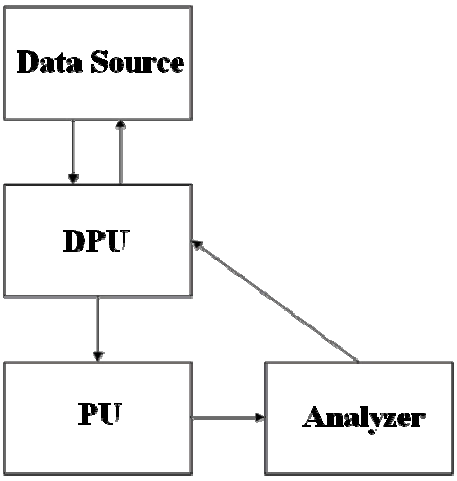

Figure 1. Basic building blocks of the system. Data Source – streaming data, this can be received from unmanned aerial vehicle. DPU – data processing unit. PU – preprocessing unit. Analyzer – data analytics unit

Data Processing Unit Data processing unit allows to solve two major issues: receive and format (or decoding) input data to make it acceptable for analyzer; format (or encoding) the resulting data for transmits it over channels of communication to the sender (UAV, ground stations, etc.). Preprocessing Unit is used for data preparation either for more effective analytics or for visual improvement of digital graphic information which is represented in structured block after DPU's work is finished. Main features are glow (Fig. 2c), digital stabilization (Fig. 2b), edge (Fig. 2c) of images and video. Main features of Analyzer, based on methods [1-3], are presented on Figure 3.

a) b)

c) d)

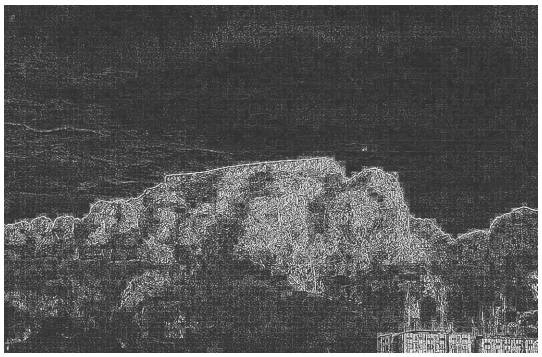

Figure 2. PU features. a – image without preprocessing; b – stabilized image;
c – low-pass filtering (glowed image); d – high-pass filtering (edges of image).

PU methods can significantly improve the results of Analyzer. They also can be very helpful for users of the system when processing data is not much legible or has a lot of graphical noise.

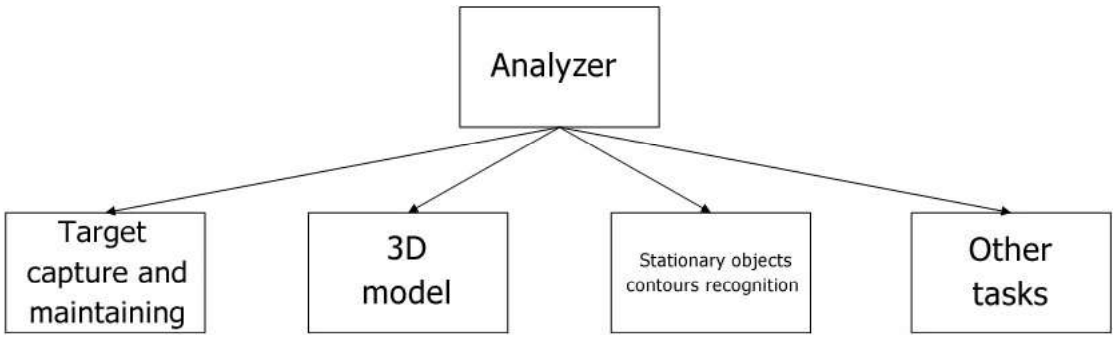

Figure 3. Basic features of Analyzer.

Here are some examples of use Analyzer. On Figure 4 video frame with feature “Target capture and maintaining” is presented. On Figure 5 is presented horizon detection which is a part of “Stationary objects contours recognition” feature.

Figure 4. Target capture and maintaining.

On Figure 4 we can see the system has detected objected and maintaining it. The system can also detect and maintaining multiple objects.

Figure 5. Video frame where horizon line has been detected

Here(Fig. 5) we can see real time detection of horizon line on the video received from design office “Virage”.

One of the important tasks of the system is texture recognition. It can be used to locate hardly noticeable to the human eye objects. As example below (Fig, 6) illustrated searching settlements at image obtained from Landsat [5] satellite.

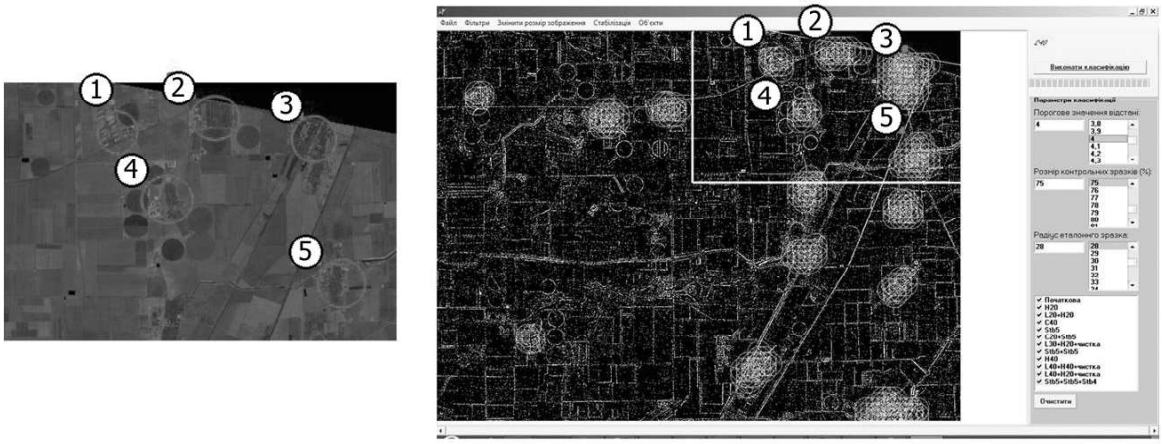

Figure 6. Example of texture recognition.

The system can be used for processing of air photo data, for example image scaling. (Fig. 7).

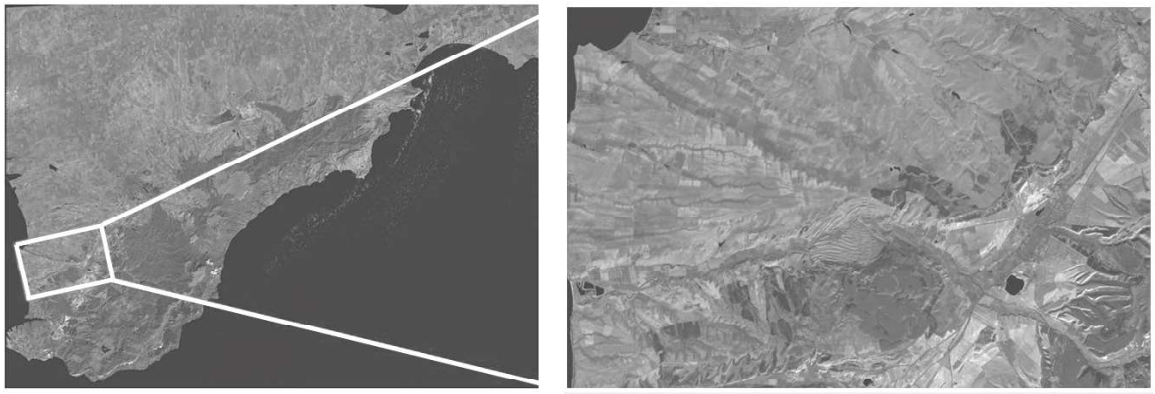

Figure 7. Scaling of a fragment of image obtained from Landsat.

The distortion of the image caused by camera angle can be removed using rectification methods. In the case of perspective rectification we need to know 4 pairs matched points on a map and on a photo. As a result, we get undistorted image, which can be used as a part of a detailed texture of 3D surface. For example, overlay the photo from “M-10 Eye” constructed in with the design office "Virage", at a fragment of a Google Maps [4] (Fig. 8).

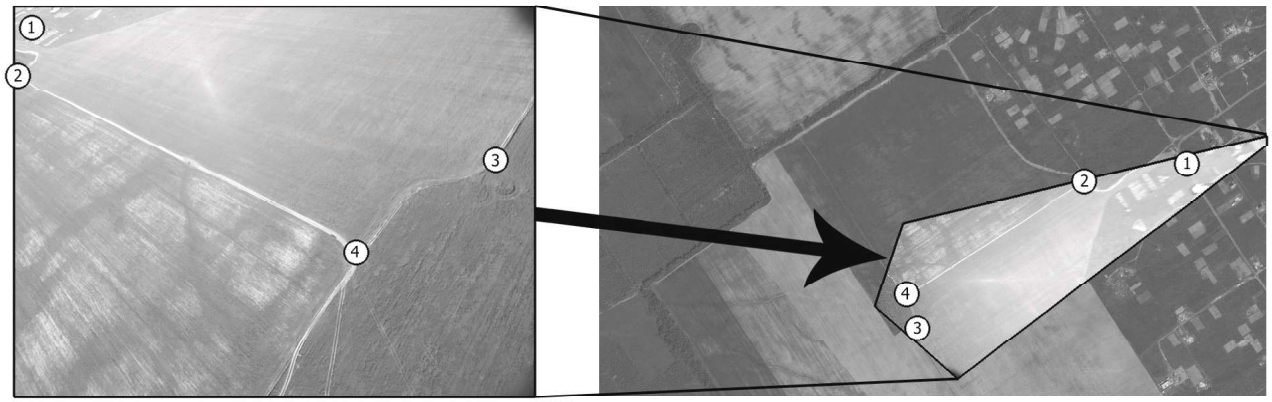

Figure 8. Perspective rectification.

Interactive three-dimensional model of terrain allows conducting flight simulation aircraft, quickly assessing the situation even in the absence of video and more. As an initial data for 3D model can be physical map and rectified photos (Fig. 9).

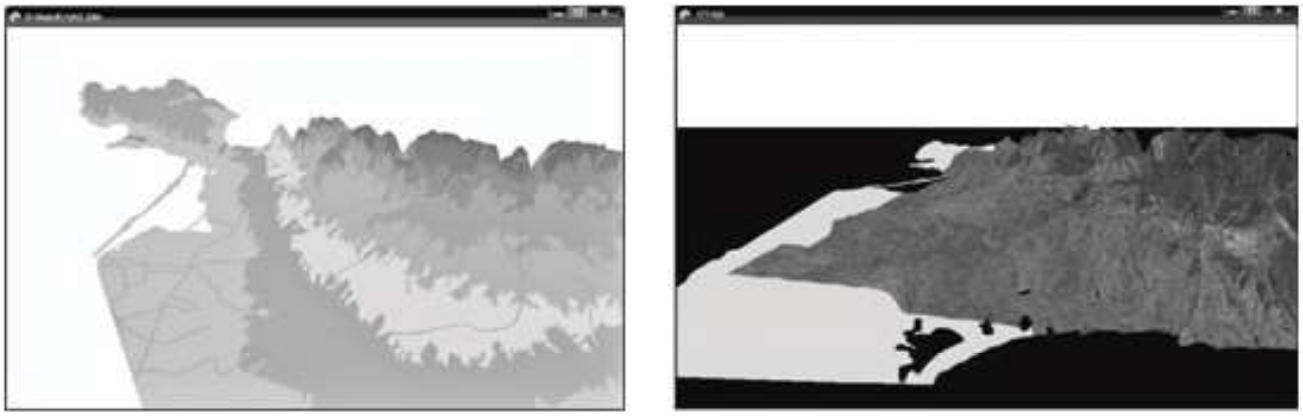

Figure 9. 3D model of Crimea with different textures.

Conclusions

The offered information technology processing of data obtained from UAV include four main components: Data Source, DPU, PU and Analyzer.

Automated system can perform preprocessing of the data, dynamic target capture and maintaining, horizon detection, texture recognition, 3D models of terrain constructing.

The results may have application in developing aircraft simulators for training pilots, navigation systems, three-dimensional catalogs of maps for quick display of remote sensing, monitoring the current status of the airspace and so on. Further research may suggest the improvement of the proposed technology for specific types of aircraft.

References

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4. Google Maps: https://www.google.com/maps

The Landsat Program: http://landsat.gsfc.nasa.gov/