STRUCTURE AND COMPOSITION OF SPECIALIZED SOFTWARE TOOLS THAT FORM THE BASIS OF WORKSTATION SOFTWARE TO PREPARE FOR INTELLIGENCE

***Nicolay Chichvarin**, Ph.D., Associate Professor, Moscow*

List of abbreviations.

AFA - aerial camera ,
РЛС - airborne radar ,
RS - remote sensing of the earth,
GIS - Geographic Information System,
LA – aircraft,
LLS - laser radar station,
IR - infrared range (0.8 - 30 microns),
КЛА - spacecraft ,
ECO - Optoelectronic system
Software - Software
РЛС - radar ,
BO- radar side-view,
SVKR - means of air and space exploration,
SVR - the means of aerial reconnaissance,
PAR - phased array antenna
DEM - digital elevation model,
EC - the electronic card.

Introduction.

This article contains material on software systems of data processing aerial reconnaissance , remote sensing and training intelligence and based on an analytical review of the literature evaluated the known means of recording and ground processing of intelligence data mapping and GIS. As was shown by the authors of publications in analytical review and the means of remote sensing [1,2, p.p. all], according to the proposed concept of the formation of the initial data for the subsequent decision of the objectives of the TOR for R & D , there are a number of features of their training. Register terrain images often must be made quickly, without the possibility of recurrence. The terms of photography is not always possible to obtain high-quality images. Images can be defocused and blurred, especially if the pictures are made using equipment installed on the UAV. In [1, 2, all p.p.] that for the most rapid and detailed aerial application of UAV most preferred . UAV unlike manned aircraft can be used in adverse weather conditions and at low surface brightness. Furthermore, it is shown that the apparatus.

Aerial photography that is installed on the UAV, in the overwhelming number of the multichannel. As a rule , suppliers of aerial photographs made UAVs have software that solves the problem of " cross-linking " of images of the fragments . However, the solution of this problem in various ways, far satisfy the requirements of the aerial photos, solve the problem posed in the TOR for research. Therefore, the composition of specialized software, enter the following means:

- Software for restoration of defocused images.
- Software to compensate for blurring,
- Software for filtering noisy images,
- Software for the «cross-linking» of aerial photographs of the fragments.

1. Results of an analytical overview of the available publications

A review undertaken by the publications [1, 3] and the results of a survey conducted in articles[5 -8]. According to the analysis, the results of which are shown above, in the modern GIS tools to compensate for the factors considered are not provided. Part of the problem of filtration and special treatment images partially solved with the help of software package MATLAB. Historically, however, the complex was formed and is accompanied for the «art» of processing media files. Special solutions for the problem of processing tasks with the help of aerial photographs are not solved. With this program, Photoshop Extended, you can also consider the MATLAB image, process it in the program Photoshop, combined with the technology team MATLAB image processing Photoshop. Once a connection is established with the program Photoshop from MATLAB program and is used to enter commands into the command line MATLAB, these control actions are carried out in Photoshop. Files prepared in the program MATLAB, have the extension m, fig, rpt, mat, mdl. Communication between Photoshop and MATLAB interface uses Photoshop JavaScript library interface and MATLAB.

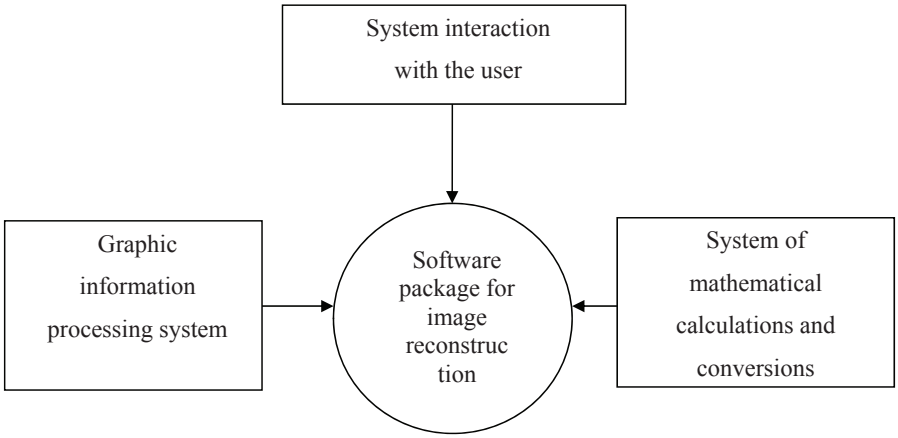


***Fig. 2**. The structure of the complex.*

However, this path is «overloaded». Therefore, necessary to develop specialized software. In the papers [1, 2], the authors of this report show the original methods and algorithms for solving these problems.

2. Описание результатов разработки

The structure and composition for workstation:

Function of the main components that make up the software «frame».

- Software Group in block 1 is designed for the following applications :
  - Support for input images, and navigation data from the memory card recorder ,
  - Support of the recording process recorded images and navigational data.
- for imagery archive SVR " designed for archiving images recorded in the memory cards of manned aircraft.
- PA «archive EC» is designed for archival storage of EC and DEM.
- The software user interface is designed to support the operator.
- The control program is complex:
  - To provide access to GIS Customer;
  - To protect the data produced by using APM "Shot" from unauthorized access;
  - To manage the software «Shot».

6) PA «system log» is designed for access control and operator actions. This program provides authorized access and registration of operator and all authorized AWS «frame». Actions staff during routine maintenance are also recorded.

Description of the functional diagram software workstation software «frame».

The organization software:

The software package is built on the principle of organizing the block that includes multiple modules as independent from each other and interacting only with defined interfaces. If properly organized, it will simplify the modification, and to focus only on the individual modules. Also this increases the stability of the system.

This software product can be considered as a combination of the following logic blocks.

System user interaction:

Provides a convenient interface for controlling image processing, which is made using the standard Delphi.

Image information processing system .

Provides access to the elements of the image. Provides the ability to read and write images in a variety of formats. The system includes standard and specially designed tools.

The structure of a software system defocusing After starting the application, the user must make a choice in favor of one of the proposed options.

Consider the work of software for the restoration of defocused images.

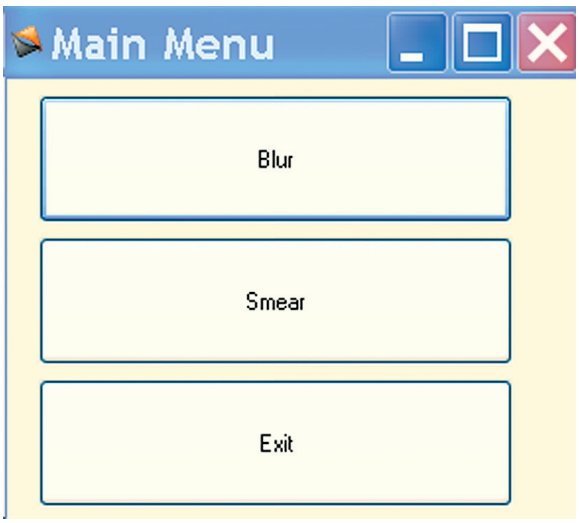


Fig. 3.

The user is given the opportunity to test the reconstruction and modeling of defocused images. The original window is as follows:

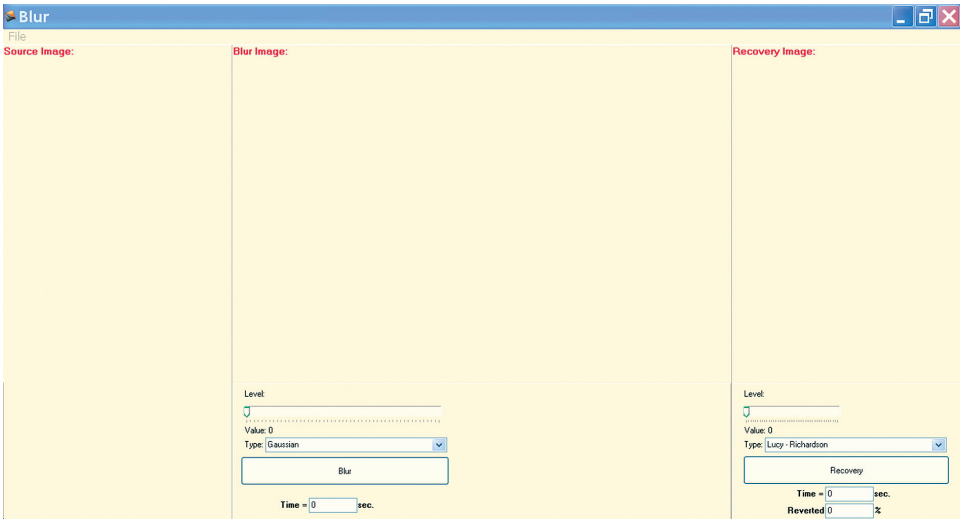


Fig. 4.

The user is given the opportunity to test the reconstruction and modeling of defocused images. The original window is as follows:

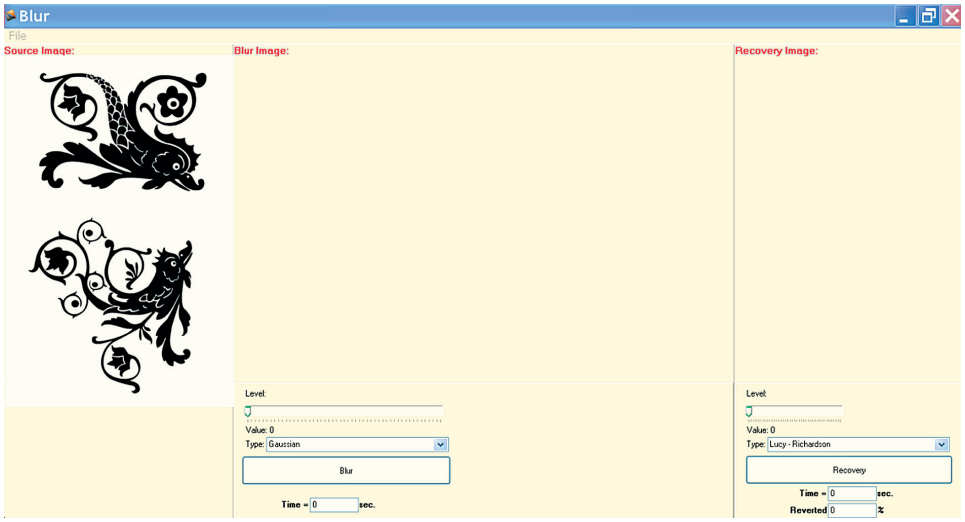


Fig. 5.

The user is given the opportunity to test the reconstruction and modeling of defocused images. The original window is as follows:

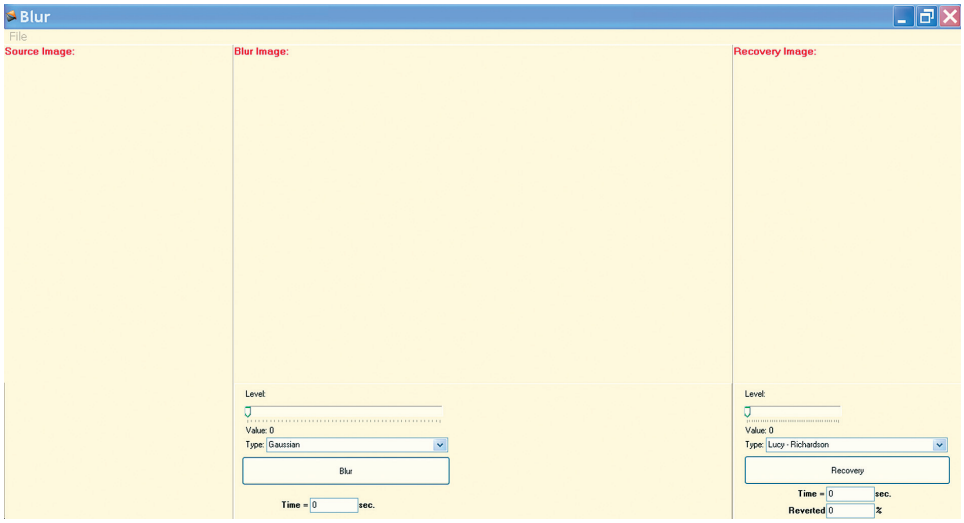


Fig. 6.

Functional area is divided into three parts. The first is used to display the original image. To do this, select the file in the study drop-down menu «Open».

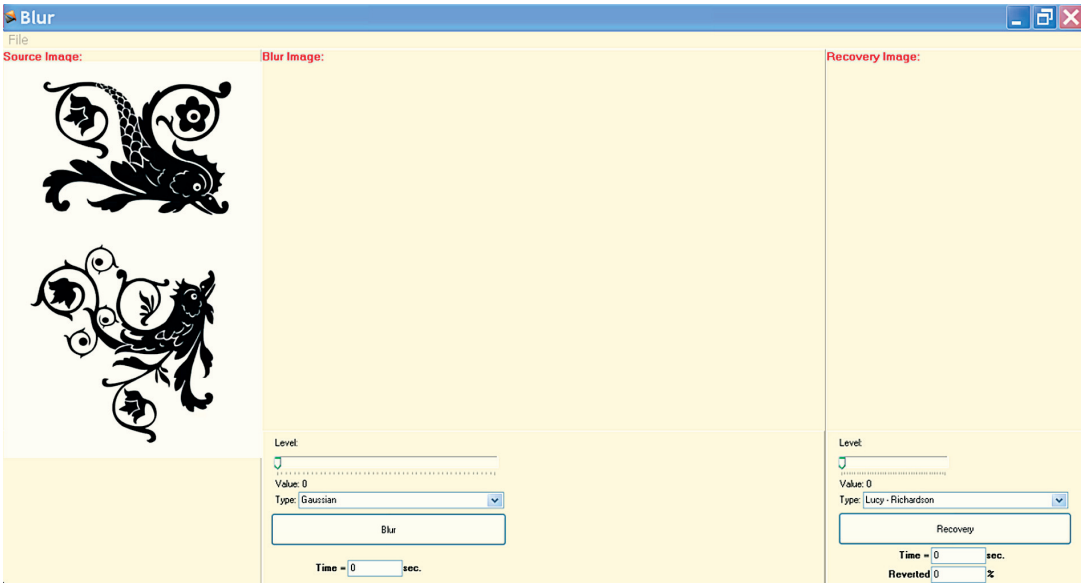


Fig. 5.

The second functional area is used to display the results of modeling of defocusing. Distortion parameters and the method of determining the blur kernel, installed by the user. The following parameter setting window is fixed processing times. Starting the simulation is carried out by pressing the «Blur».

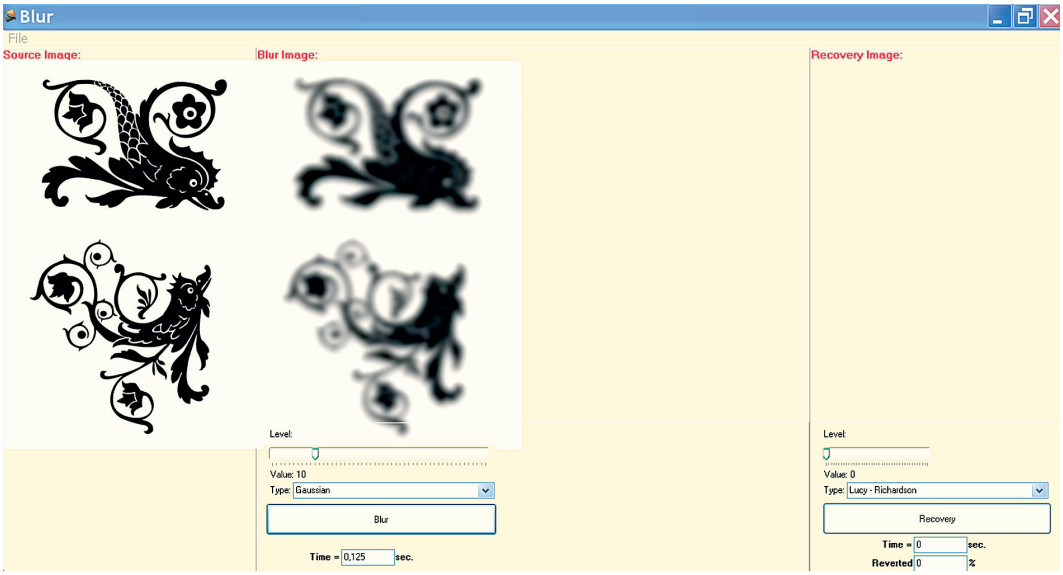


Fig. 6.

The third functional area is designed to recover defocused image. There are two methods of recovery: blind deconvolution algorithm and Lucy-Richardson. After selecting a user starts the recovery process by pressing the «Recovery».

In the lower part of the window has to display the time and quality recovery. However, it should be noted that the rate of recovery of quality should be used only to restore the model variant defocus when you know the reference version of the image. Thus, it becomes possible to compare the two images. Result recovery blind deconvolution method.

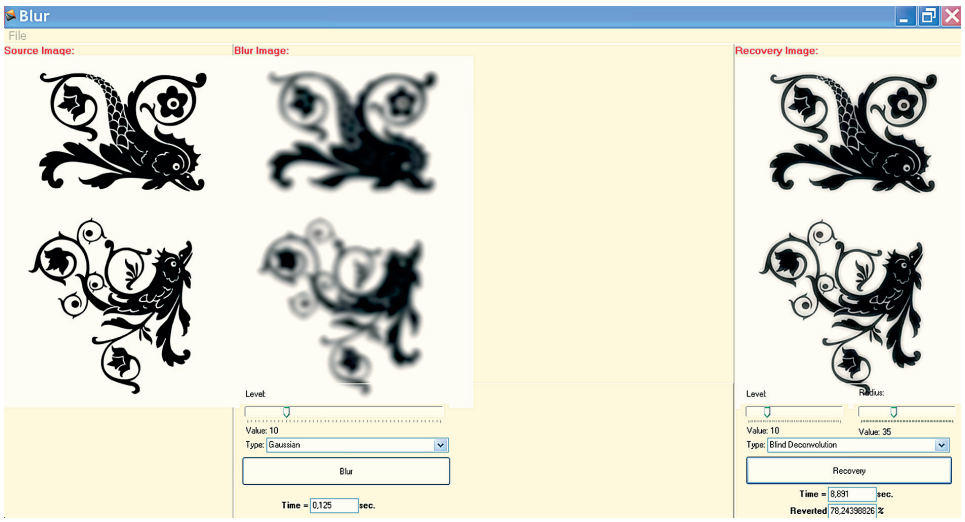


Fig. 7.

Grease

After selecting the menu item «smear», the user becomes available tools for modeling and editing of blurred images. The newly Affairs functional area is divided into three parts.

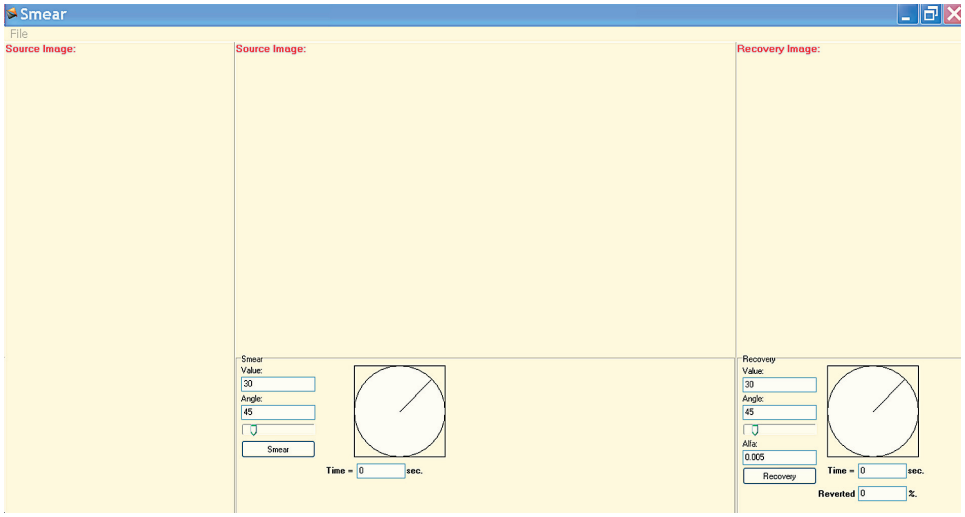


Fig. 8.

The first functional area is designed to display the original image. Second - for the model based on the blurring of the original image. The user specifies the magnitude and direction of the blurring. Launch processing by pressing «Smear». Below the screen is a window to display the time of processing.

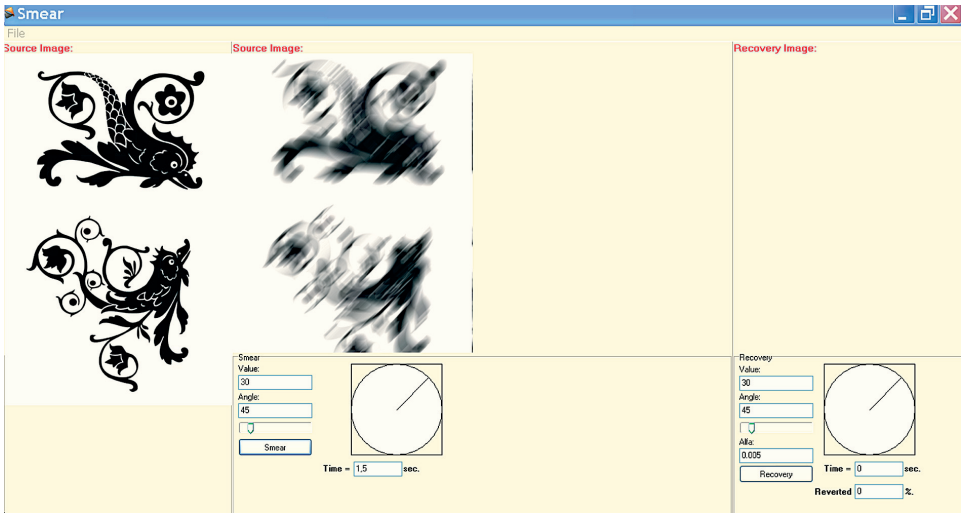


Fig. 9.

Last functional area is used to display the results of recovery. The parameters are also set by the user. There are fields to display the time and quality of recovery. As in the case of defocusing, should evaluate the quality recovery when the model only embodiment, when the known reference version of the image.

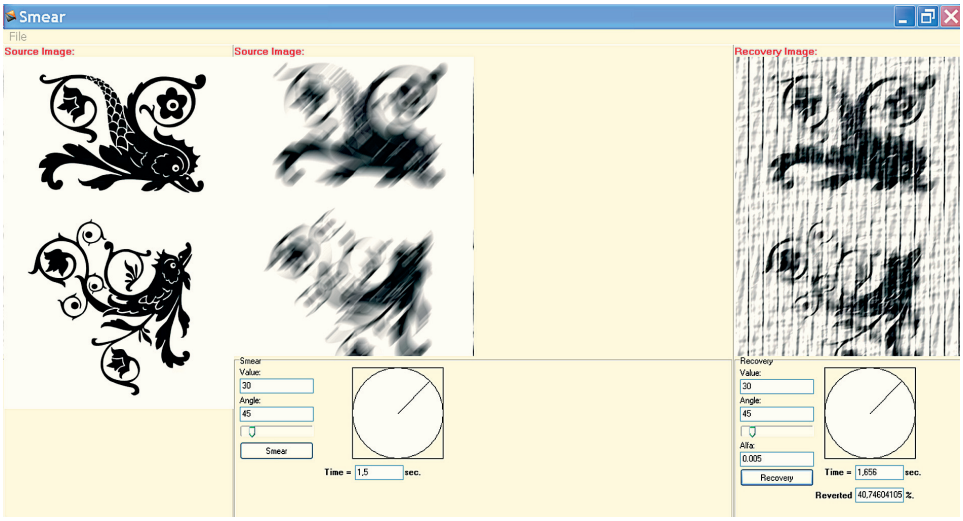


Fig. 10.

3. Experimental part.

For the experiment, images were made using various aerial cameras. Snapshots are the black and white image world (test objects used to determine the resolution of the optical system). The first image obtained by AFA 54/100 under the "Open Skies". Second (World) - through AFA e-magazine. Images were made using various aerial cameras. Snapshots are the black and white image world (test objects used to determine the resolution of the optical system). The first image obtained by AFA 54/100 under the "Open Skies". Second (World) - through AFA e-magazine.

Original Images

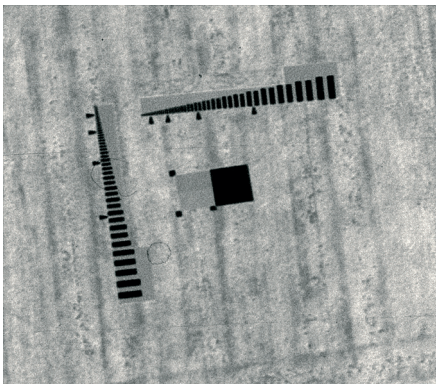
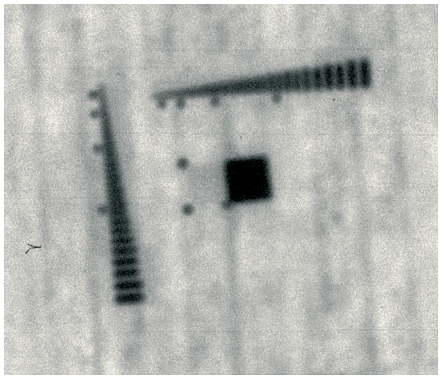
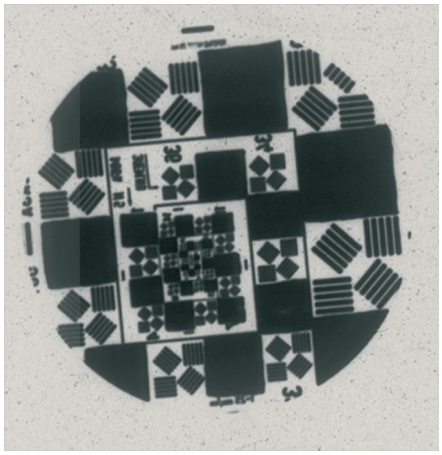
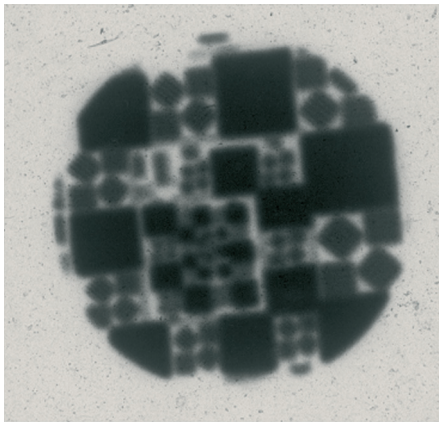
Photos without filter (focussed)	Photo filter (defocus)
	
	

Fig. 11.

Submitted images taken with AFA , using a filter , have a number of features.

First, it is not known what is the value of defocus . Second, it is not clear what the point spread function (the kernel) is the basis of the filter. And finally, what is the structure of the filter? It may be linear and nonlinear. In the first case, we can talk about restoration, and the second - is, at least, difficult. The problems solved by the software. With software system can solve both direct and inverse problems of defocusing and blurring . That is a clear image blur with the specified parameters and defocus blurring and restore blurred image by adjusting the parameters.

Concepts associated with the test photographs.

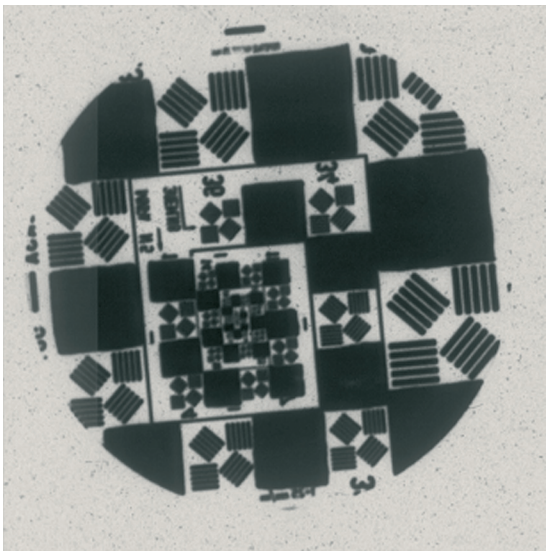


Fig 12.

The ideal case.

Under the ideal case we mean the modeling of defocusing or blurring their own. Thus, we know the recovery phase values of key parameters distorted image.

Defocusing

Experience 1. The basis - the image of the test object number 1.

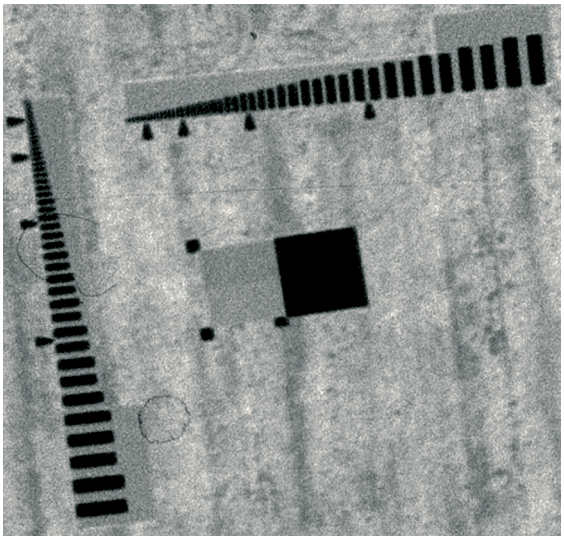


Fig. 13.

Model the defocus with the use of two different kernels on methods of Gauss and Tikhonov. Conduct a series of attempts to restore to the variation of parameters and methods of recovery.

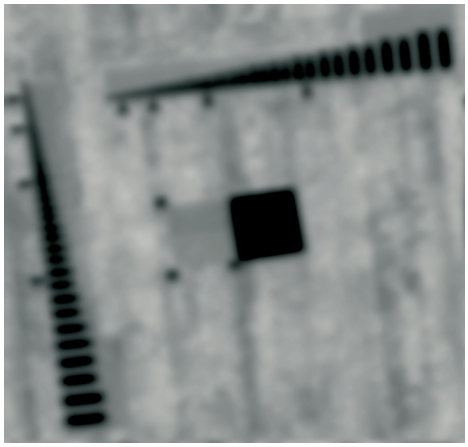
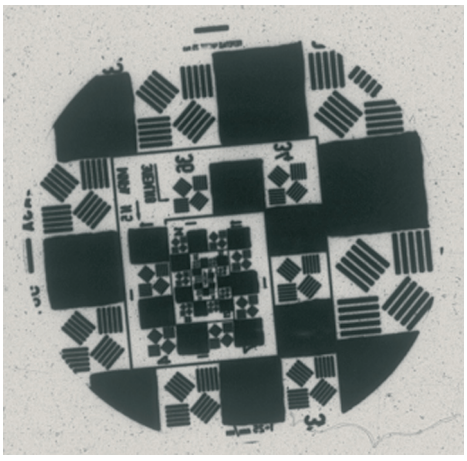
Photo filter (defocus)	Result recovery, comment
Blur gaussoide with parameter 10 	Lucy-Richardson method with parameter 10 

Fig. 14. *Legend: A regularization method according to Gauss - T, the Tikhonov regularization method - T, Lucy-Richardson = LR, blind deconvolution method = DM. [3, p.120].*

As can be seen from the experience, recovery occurs at a high enough level, however, the change of parameters does not change the result.

Lucy-Richardson method with a parameter recovery 10

Experience 2.

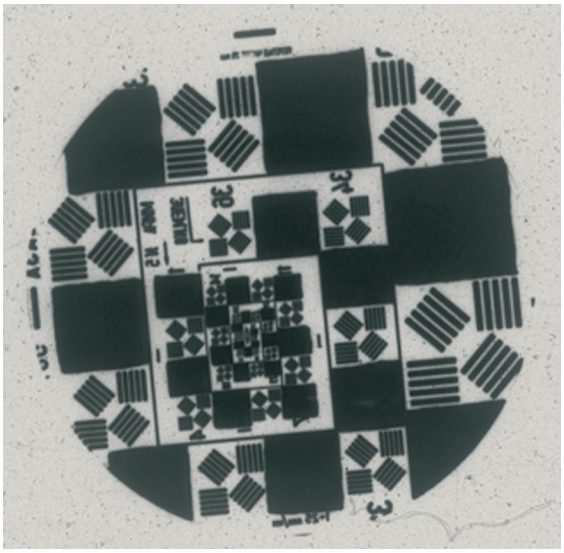


Fig. 15. *The basis - the image of the test object number 2.*

Original Image Result recovery comment.

The specificity of the photos are of a normal camera is the large amount of noise that adversely affect the quality of pictures and complicate the recovery process.

Since the lubricant at the facility take place only on the drum, it makes no sense to process the whole image, you can cut only a part of interest to us. It also greatly enhance the performance characteristics of recovery and make manual parameter selection is not as long and tedious.

Grease

- The original image. 2 - Result recovery comment. 3 - Grease angle 30 45. 4 - Restoration of 30 alpha angle 45 0.05. 5. - Restoration of 30 alpha angle 45 0,005. 6. - Cooldown 30 45 alpha angle 0.0005

With the increase of the parameter alpha have a sharpening of the reconstructed image. There is a more detailed restoration, but the artifacts are more significant. By varying the parameter values have a strong blurring distortion during recovery. Parameters value of smear and smear angle of the vector are the most important for recovery. Not their strong deviation from the correct value causes significant errors in the recovery.

Defocusing.

Fig. 18. *Attempts to restore the original image. The parameters are not known. 1. - LR 5. - LR 20*

The example was chosen picture small figure 16 as it reduces the waiting time lapper recovery. As can

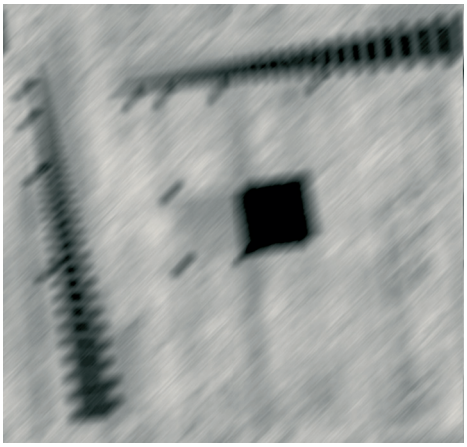
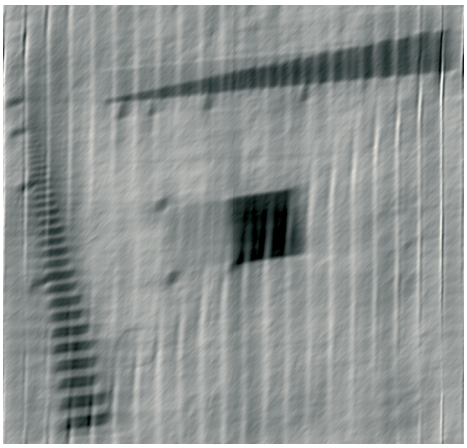
The original image	Result recovery comment
Сма angle of 30 45	Restoration of 30 angle alpha 45 0.05
	

Fig. 16. *Gaussian Blur with a parameter 5. Recovery HR 5. Recovery CD 5 – 10.*

be seen in the picture displayed digit "2", the image is part of the drum located worlds experimental setup.

restored when:

- the blurring - 22
- Direction - 90
- regularization parameters - 0.0021
- Examples of a major reconstruction of the image

are shown in Figures 18 and 19.

You can see that the image of the worlds from the drum recovered at 0.001 regularization parameter, although it has an effect enhanced interference.

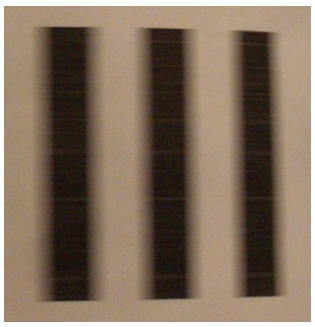


Fig. 18.

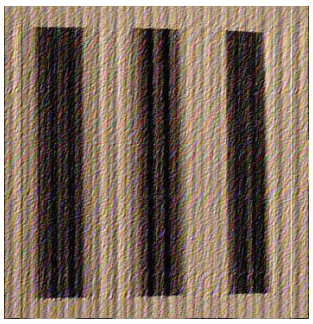
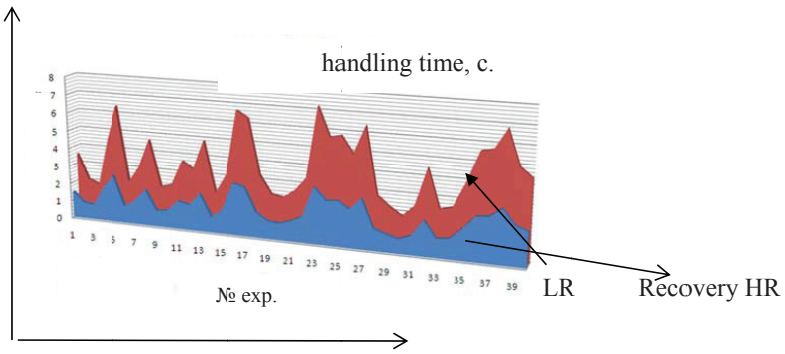


Fig. 19.

Fig. 20.



Analysis of the rate of recovery.

Compare the speed of image processing methods implemented: Lucy-Richardson and blind deconvolution. For the experiment, we will restore the parameters constant and fix them at 10 degrees for recovery. In the experiment using both color and black-and-white images. Below is a portion of the images used for the reconstruction in the experience.

Conclusion.

The program complex preparation intelligence based on the analysis of air and space exploration from a survey. The results of numerical experiment to compensate blurring and defocusing . Found that the quality of the aerial significantly affect the conditions. Factors blurring and defocusing are largely driven system navigation LA and stabilization of aerial cameras. A model of the flight dynamics in a stochastic effect on the aircraft flight parameters especially on the UAV.

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