

Results of the satellite images restoration by frames of the telescope and with algorithms of the corporation “Vympel” (2007 г.)

Some examples of frames which were used for image restoration and results of the algorithm performance are given in this report. All the images are obtained by Vygon V.G.

1. Restoration of the satellite “Champ”.

It is the Germany satellite launched for investigation of the Earth and ocean surface. It works in the common system with the Argentina satellite “SAC-C”.

For restoration there were used 25 frames of size 256x256 pixels.

Below can be seen the first and the last of these 25 frames :

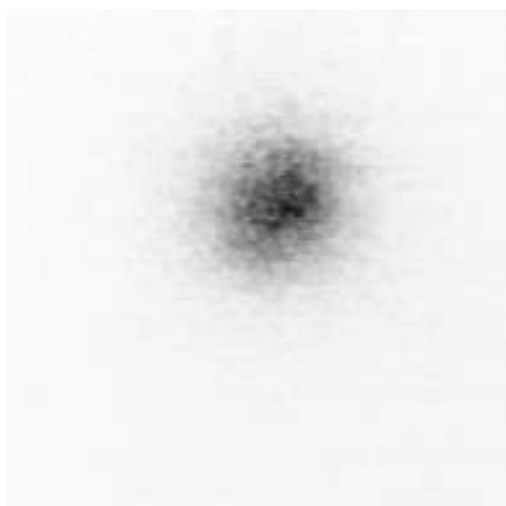


Fig 1.1 1 – st frame

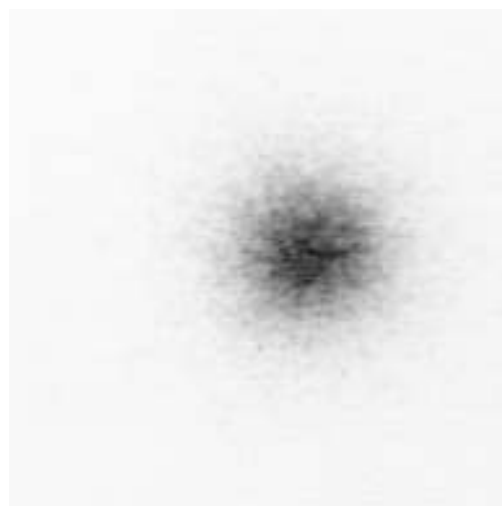


Fig 1.2 25- th frame

In Fig 1.3 the restored image is shown.



Fig 1.3 Restored “Champ”(39-th iteration).

Below at Fig 1.4 the same restored image is shown but its size is enlarged, two times relative to the image received in the process of restoration, in other words relative to the sizes of initial frames (for the better visualization), and the enlarged frame is cut off in the range of the empty space.



Fig 1.4 The image enlarged two times.

For comparing a photo of the satellite is given at Fig 1.5. It was taken in the Internet.



Fig 1.5 The photo of satellite in the Internet.

From Fig 1.4 and Fig 1.5 we can see, that two elements of the satellite construction are visible :1) the body of satellite has a shape of parallelepiped. It is situated along the horizon. .

One antenna rises from the body . Another antenna is visible on the left from the body. In Fig 1.5 all the antennas are packed and lie in a transparent cover. At Fig 1.4 the panels didn't come out.

At Fig 1.6 the image from Fig 1.3 is given once more. The lines of the most bright gradients of image are shown with red color. It can be seen that these lines emphasize the body of satellite and the contours of two antennas – one under the body and another on the left from it .



Fig 1.6 The image with the red underlined edges.

2.Restoration of the satellite “Adeos”.

It is the Japanese satellite launched for the Earth and ocean observing. It works for developing next- generation Earth Observation Systems.

For restoration there were used 25 frames of size 256x256 pixels.

Below can be seen the first and the last of these 25 frames :

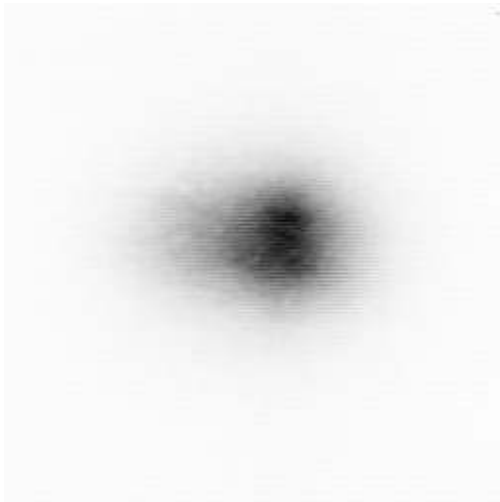


Fig2.1 1 – st frame

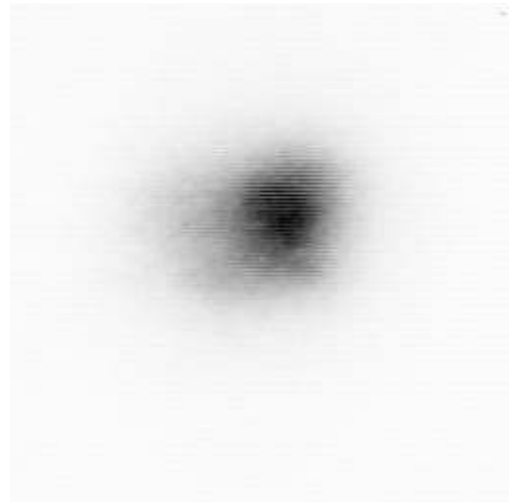


Fig 2.2 25- th frame

In Fig.2.3 the restored image is shown.



Fig 2.3 Restored “Adeos”(52 – nd iteration).

Below at Fig 2.4 the same restored image is shown but its size is enlarged , two times relative to the image received in the process of restoration, in other words relative to the sizes of initial frames, and enlarged frame is cut off in a region of the empty space.



Fig 2.4 The image enlarged two times.

For comparing a photo of the satellite is given at Fig 2.5. It was taken in Internet.

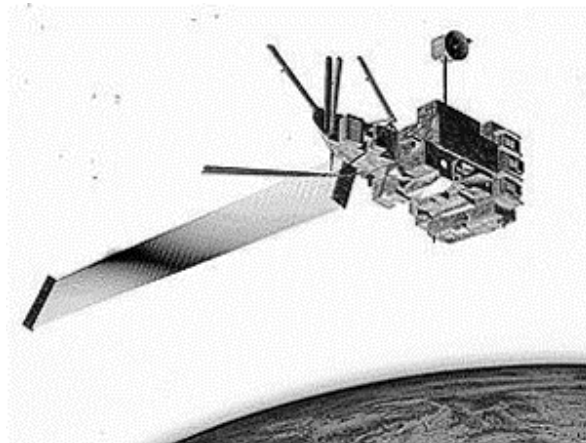


Fig 2.5 The photo of satellite in the Internet.

From Fig 2.4 and Fig 2.5 we can see , that some elements of the satellite are visible :1) the body of satellite that has a shape close to a cube ; 2) a single big panel that is disposed on right from the body .

At Fig. 2.6 the image from Fig 2.3 is given once more. The lines of the most bright gradients of image are shown in it. It can be seen that these lines emphasize the body of satellite and contours of the main panel placed on right from the body .

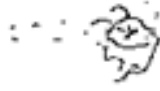


Fig 2.6 Edges of the image at Fig 2.3.

2A.Restoration of the satellite “Adeos” with another file sequence.

For restoration were used also 25 frames of size 256x256 pixels.

Below can be seen the first and the last of these 25 frames :

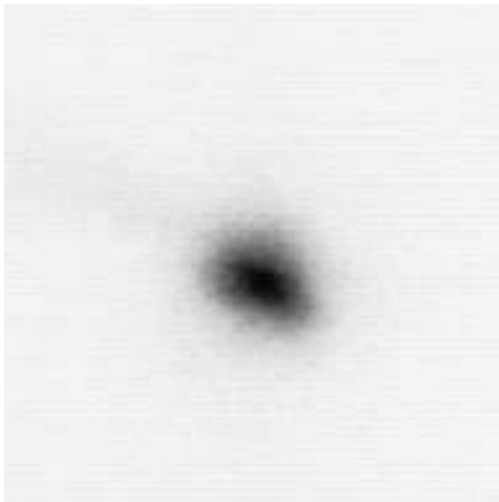


Fig2A.1 1 – st frame

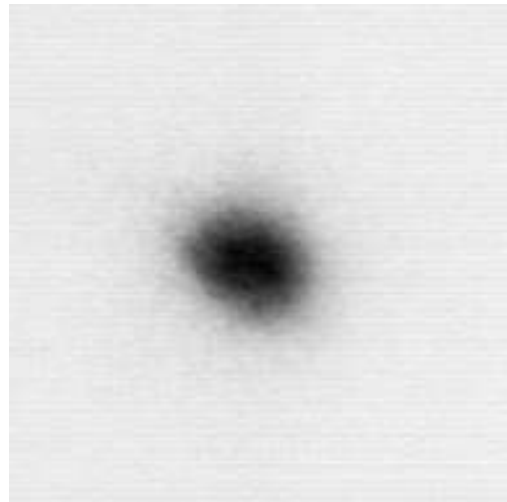


Fig 2A.2 25- th frame

In Fig.2A.3 the restored image is shown.



Fig 2A.3 Restored “Adeos”(41-st iteration).

Below at Fig 2A.4 the same restored image enlarged two times. It is seen from Fig 2A.3 and Fig 2A.4 that the satellite was turned on ~ 135 degrees relative to its aspect in the previous case of restoration. As a result a new element of a round shape became visible in such aspect. And the element of a cubic form isn't visible so distinctly. It looks like the distance to the object was much larger than in the first case of restoration and its dimensions came out about twice smaller.



Fig 2A.4 The image enlarged two times.

At Fig. 2A.5 the image from Fig 2A.3 is given once more. The lines of the most bright gradients of image are shown in it. It can be seen that these lines emphasize the body of satellite and contours of the main panel placed on right from the body.



Fig 2A.5 Edges of the image at Fig 2A.3.

3. Restoration of the satellite “Meteor-1”.

It is the Russian weather satellite.

For restoration there were used 25 frames of size 256x256 pixels.

Below can be seen the first and the last of these 25 frames :

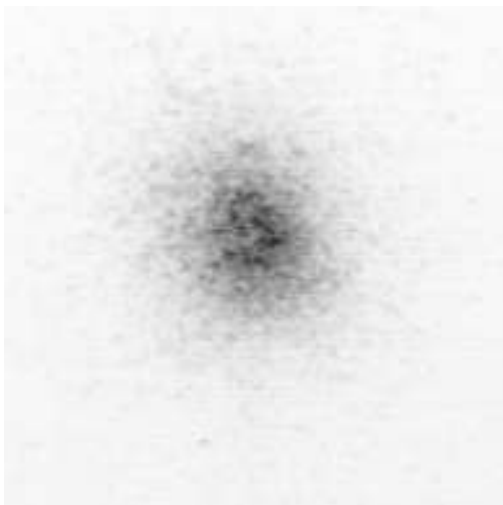


Fig 3.1 1-st frame

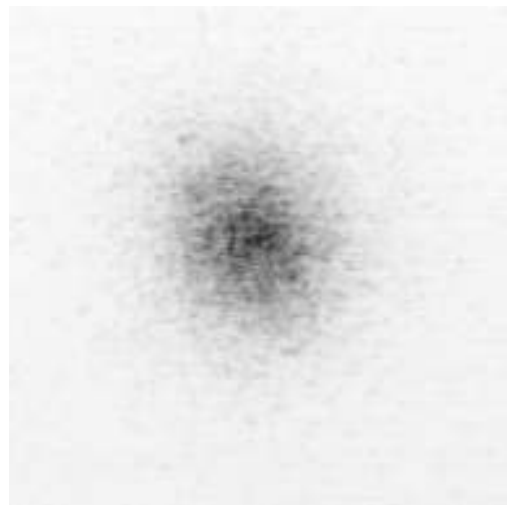


Fig 3.2 25-th frame

In Fig 3.3 the restored image is shown.



Fig 3.3 Restored “Meteor”(9-th iteration).



Fig. 3.4 The image enlarged two times.

For comparing a photo of the satellite is given at Fig 3.5. It was taken in Internet.



Fig 3.5 The photo of satellite in the Internet.

From Fig 3.4 and Fig 3.5 we can see , that some elements of the satellite are visible :1) the body of satellite that has a cylindrical shape and ends in another more narrow cylinder ; 2) there are some antennas around the body . These antennas are absent in a photo of the satellite

At Fig 3.6 the image from Fig 3.3 is given once more. The lines of the most bright gradients of image are shown in it. It can be seen that these lines emphasize the body of satellite and contours of antennas.



Fig 3.6 Edges of the image at Fig 3.3.

4.Restoration of the satellite “Lacrosse-3”.

It is the American satellite for radar imaging of objects on the Earth surface .
For restoration there were used 9 frames of size 256x256 pixels.
Below can be seen the first and the last of these 9 frames :

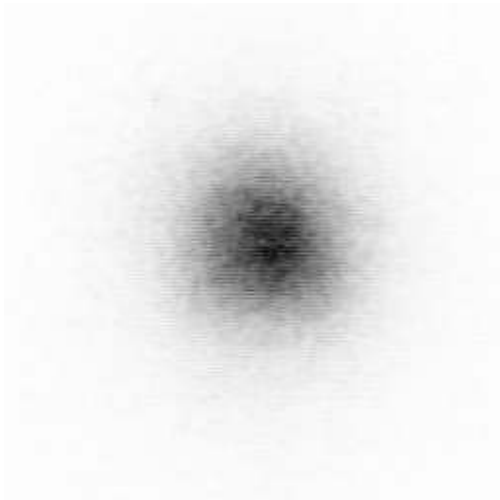


Fig4.1 1-st frame

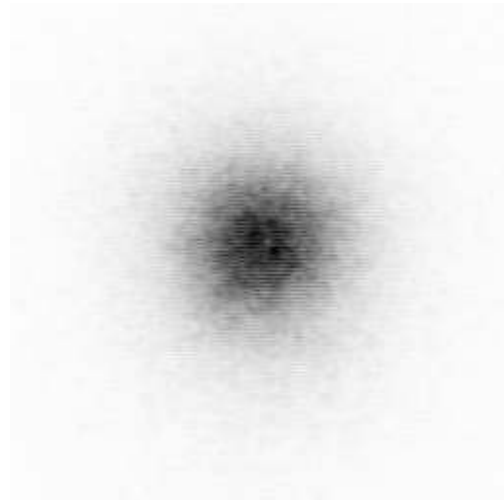


Fig 4.2 9-th frame

In Fig 4.3 the restored image is shown.



Fig 4.3 Restored "Lacrosse-3"(23-d iteration).

At Fig 4.4 the same restored image is shown but its size is enlarged , two times relative to the image received in the process of restoration.



Fig 4.4 The image enlarged two times.

From Fig 4.3 and Fig 4.4 we can see , that some elements of the satellite are visible :1) a big antenna in a form of a bowl which scans the Earth surface with a broadband signal; 2) antenna for synthesis of the aperture (under the antenna for scanning and on the left from it) ; 3) the body of satellite. It has a shape of a narrow cylinder and goes downwards from the bowl antenna . There is visible one more element which has a form of a line going parallel to the body , but its purpose is unclear.

At Fig 4.5 the image from Fig 4.3 is given once more. The lines of the most bright gradients of image are shown in it by red color. It can be seen that these lines emphasize the body of satellite and contours of antennas.



Fig 4.5 Edges of the image at Fig 4.3.

4A Restoration of the satellite “Lacrosse-3” by another file sequence.

For restoration there were used 25 frames of size 256x256 pixels.

Below can be seen the first and the last of these 25 frames (not of very high quality):

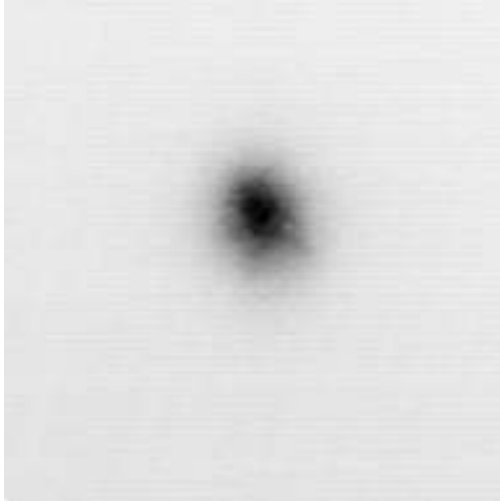


Fig 4A.1 1-st frame

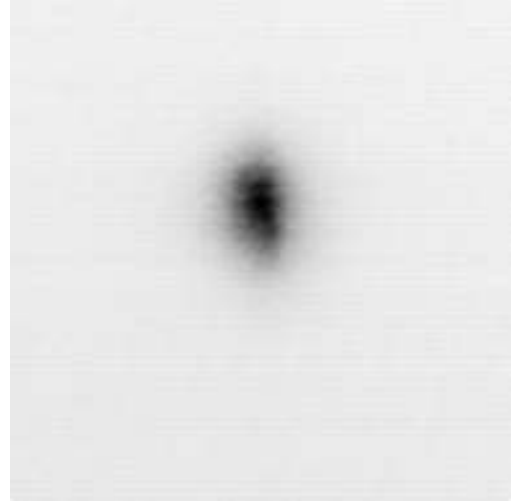


Fig 4A.2 25-th frame

In Fig4A.3 the restored image is shown.



Fig 4A.3 Restored “Lacrosse-3”(57-th iteration).

At Fig 4A.4 the same restored image is shown but its size is enlarged, two times relative to the image received in the process of restoration.



Fig 4A.4 The image enlarged two times.

From Fig 4A.3 and Fig 4A.4 we can see , that the same elements of the satellite are visible which were seen in the previous restoration, only the satellite is turned to angle ~ 90 degrees :1) a big antenna in a form of a bowl which scans the Earth surface with a broadband signal; 2) antenna for synthesis of the aperture (right under the antenna for scanning in this aspect) ; 3) the body of satellite. It has a shape of a narrow cylinder and goes downwards from the bowl antenna . Besides we can see traces of a small solar panel over the bowl antenna..

At Fig.4A.5 the images from Fig 4A.3 and Fig 4A.4 is given once more. The lines of the most bright gradients of image are shown in it by red color. It can be seen that these lines emphasize the body of satellite and contours of antennas and a small panel over the bowl antenna



Fig 4A.5 Edges of the images at Fig 4A.3 and Fig. 4A.4

5. Restoration of the satellite “Lacrosse-5”.

For restoration there were used 20 frames of size 256x256 pixels.

Below can be seen the first and the last of these 20 frames :



Fig 5.1 1-st frame



Fig 5.2 20-th frame

In Fig5.3 the restored image is shown.



Fg 5.3 Restored “Lacrosse-5”(18-th iteration).

At Fig 5.4 the same restored image is shown but its size is enlarged , two times relative to the image received in the process of restoration.



Fig 5.4 The image enlarged two times.



Fig 5.5 The image enlarged three times.

From Fig 5.3 - Fig 5.5 we can see , that the next elements of the satellite are visible in restoration, :1) a body of the satellite directly turning into a bowl shape antenna (this antenna is much smaller than the same antenna in all the previous versions of the Lacrosse satellites). This body ending with antenna is disposed in center of the image; 2) On the left and on the right from

a body two other antennas are visible . It is possible that these are antennas for communications ; 3) under the small bowl antenna the antenna for synthesis of the aperture is visible ;

At Fig.5.6 the images from Fig 5.4 is given once more. The lines of the most bright gradients of image are shown in it by red color. It can be seen that these lines emphasize the body of satellite and contours of the bowl antenna and a small antenna for synthesis under the bowl one. Also two other antennas on the both sides from the body are underlined.



Fig 5.6 Edges of the images at Fig. 5.4