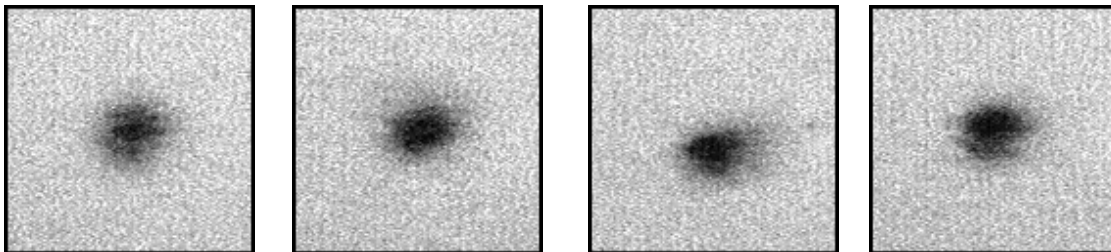


Restoration of the satellites images by the real data from telescopes with using algorithms of the Corporation “Vympel” (2006)

Some real frames used for restoration of the satellites images are shown below. Also the results of the atmosphere distortions compensation are given for the row of satellites which don't have exactly known shape and features.

1. Restoration of “Lacrosse-2”.

The 14 frames of 128x128 pixels dimension were used for restoration . Here 2 the first and 2 the last frames of these 14 ones are shown.



1-t frame

2-d frame

13-th frame

14-th frame

Below the image restored with them is shown. Its size is enlarged two times relative to the image dimensions which were being received in the process of the calculations, i.e. in comparison with the input dimensions (for enhancement of the visualization), and the frame itself is cut by its edges in the area of empty space.

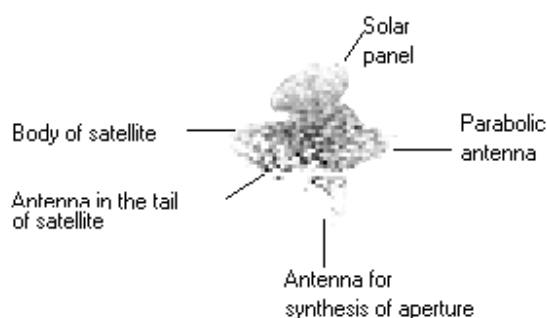


Restoration of Lacrosse2.

This frame shows existence of the 4 specific construction elements in the satellite: 1) a large round transmitting antenna in a view of a big bowl (in the right part of the figure), 2) a long straight antenna for synthesis of the aperture in time (under the round big antenna, it came out not very distinctly), 3) a body of the satellite , with a large antenna staying to the right of the body in

its tail (possibly for communications),4) the solar panel in a view of the flat surface directly over the satellite attached to the body by a vertical truss. It should be noted that a such disposition of the panel differs from its disposition in the satellites of the rising generations – there they are placed in the tail of the satellite's body. In general, the panels may be restored very seldom, because they are usually disposed perpendicularly to the Sun direction by their plane, and the satellite is well visible, if it is seen a little to the side of the direction to the Sun. The panel can be visible only if it deviated from the perpendicular to the direction of the Sun, that obviously had place in this case.

Below the image of some more large size is given to show all the specific features of the satellite.

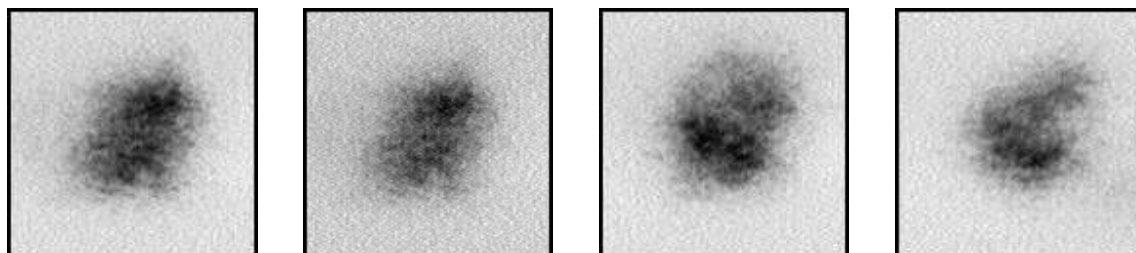


Comments to the restored image.

2. Restoration of "Lacrosse-3".

There were used 11 frames of 128x128 pixels dimensions for restoration.

Below 2 the first and 2 the last ones are shown,



1-t Frame

2-d frame

10-th frame

11-th frame

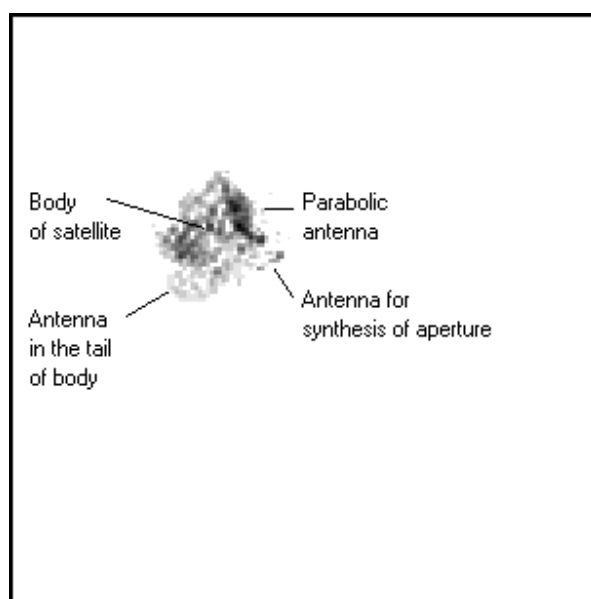
The image restored with these frames is shown below. Its sizes are enlarged two times relative to those were received in the calculation process, i.e. in comparison with dimensions of the input frames (for better visualization), and the frame itself is cut from its edges in area of the empty space.



Restored Lacrosse -3.

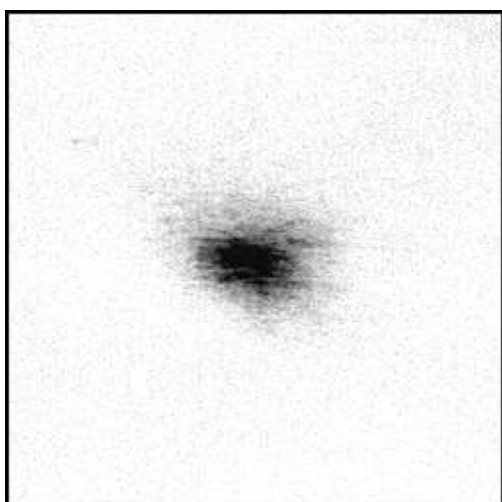
The frame shows existence of the 4 specific elements of the satellite: 1) a big transmitting antenna in the shape of a bowl (in the right part of the picture), 2) a part of the straight antenna for synthesis of the aperture in time (under the large antenna), 3) a dark short body of the satellite with a big antenna on the right of it, (possibly for communications).

Below the same image is shown at the enlarged area with description of restored elements.

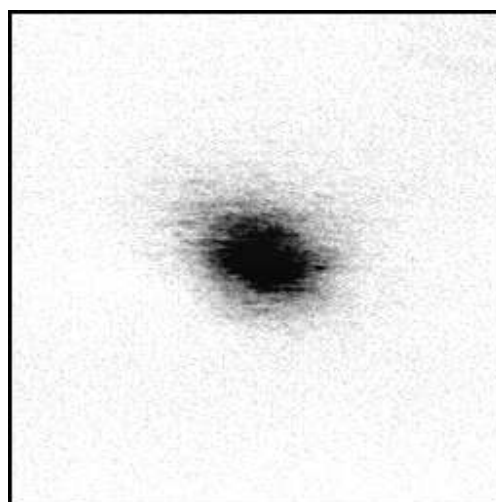


Comments to the restoration.

3. Restoration of “Lacrosse-4” with 11 frames.

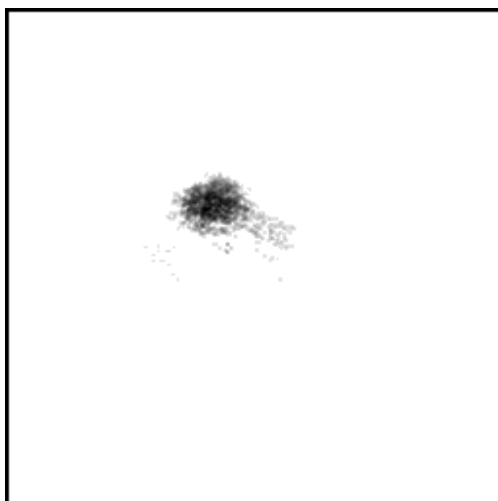


1 -t frame



11-th frame

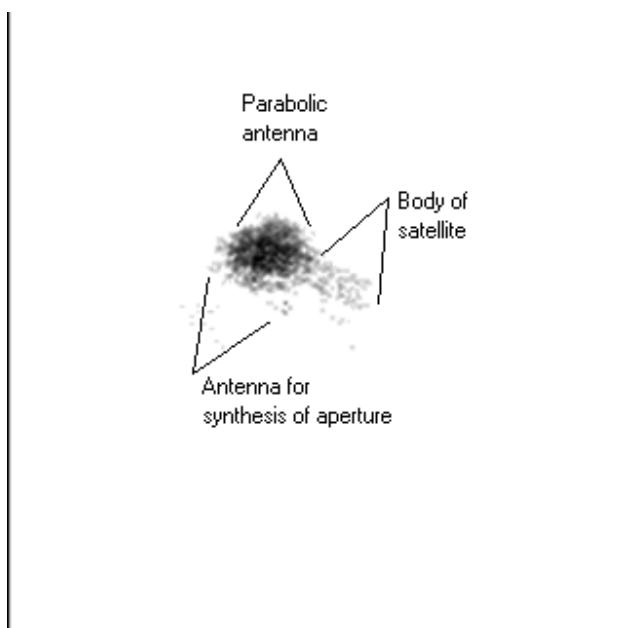
Below the restored image can be seen. This result was received at 133-rd iteration.



Restored image .

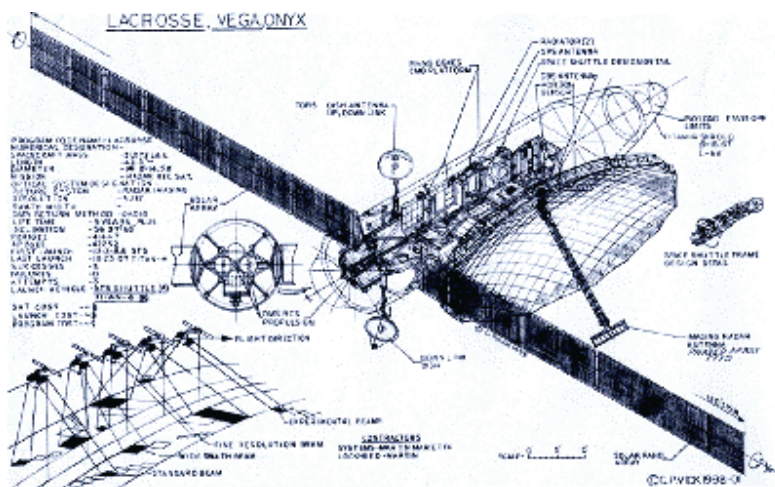
A narrow body having shape of parallelepiped and a large antenna are visible in the frame. Under the round antenna a straight long antenna for building images is visible but not very distinctly. The body of satellite has a view of a tetrahedron.

The next is enlarged image with pointers to the elements discovered in the satellite.



Comments to the image.

The following picture is a scheme of the type “Lacrosse” satellite, taken from the Internet ([LACROSSE - ONYX.htm](#)).

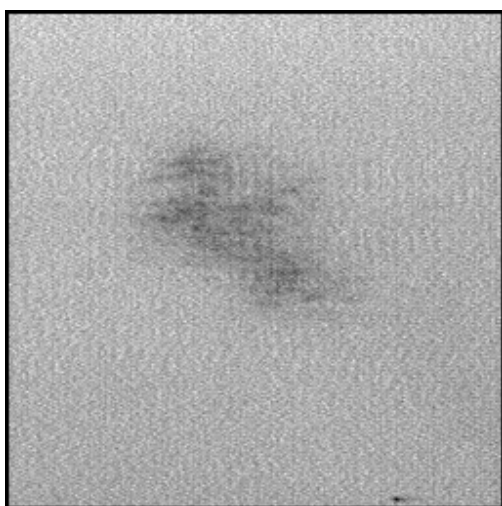


It can be noticed much resemblance between the restored image and this scheme.

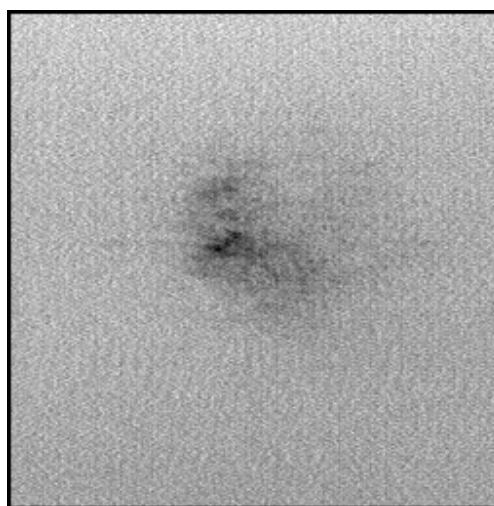
The tetrahedral body of the satellite, large antenna and straight antenna for the aperture synthesis, disposed under it are visible in the both images. Now It can be confirmed, that Internet gives rather equivalent description of the satellite ”Lacrosse 4” and doesn’t supply any obvious disinformation, as it is usually accepted to consider may be excepting the dimensions of the separate details of the satellite.

From the restored image of the “Lacrosse” satellites a conclusion may be done, that in the whole a scheme of constructing “Lacrosse” satellites is the same in its different generations, but the solar panel of “Lacrosse-2” and “Lacrosse-3” is disposed under the satellite, and in “Lacrosse-4” it is located in a tail of the satellite (it came out in a row of the other restoration variants, which aren’t shown here because of a large noise level in the image).

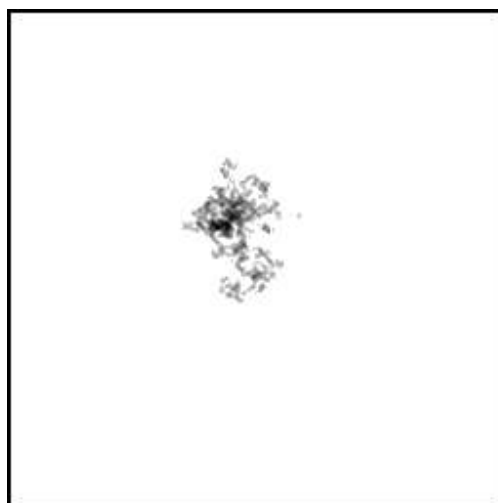
4. Restoration of the satellite “Nadezhda-6” .



1-t frame



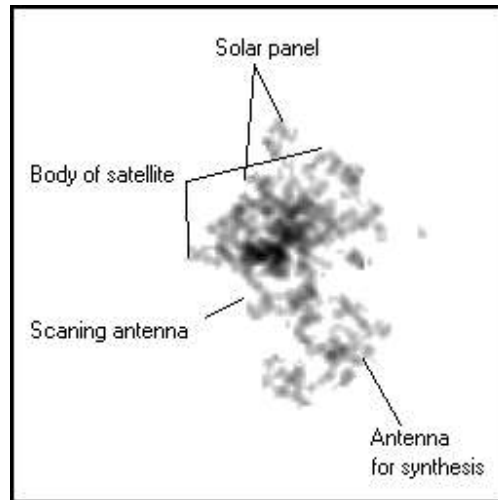
9- th frame



Restored image.

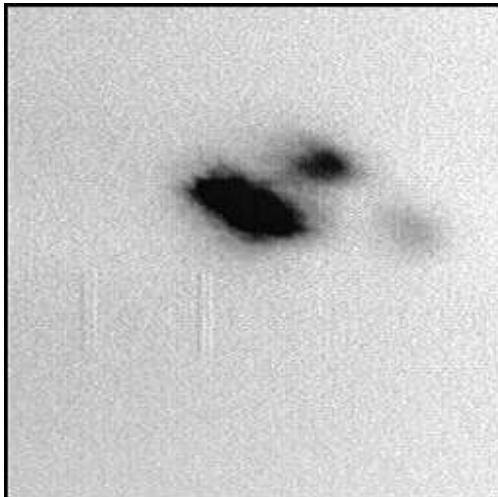
Below the image enlarged two times can be seen. There are pointed restored elements of the satellite: 1) a body of the satellite of the conical shape; 2) antenna for the Earth sounding; 3) possible it is antenna for synthesis of the aperture ; 4) a small solar panel under the body of the

satellite. It is one of the 7 satellites system for monitoring the natural disasters . “Nadezhda-7” discovers the signals of disasters and presents a navigation satellite by itself.

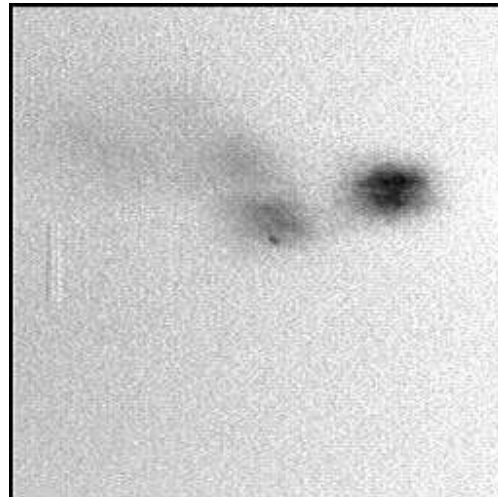


Restored image enlarged two times

5. Restoration of the satellite “Nadezhda-7” with 15 frames.



1-t frame



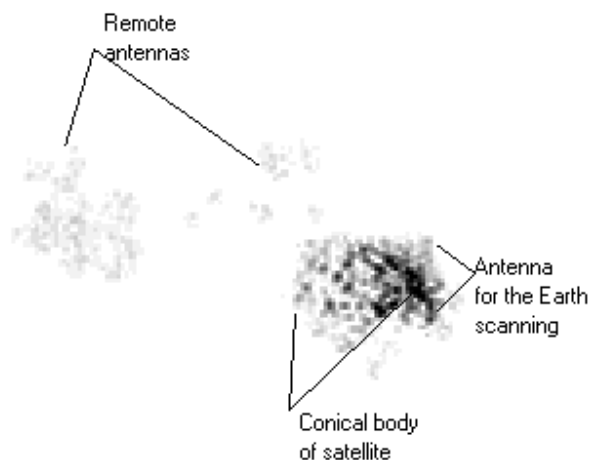
15-th frame



Restored image, enlarged two times.

This is 7-th satellite of the system for monitoring natural disasters.

It was observed by a telescope on the larger distance and with worse resolution than in the previous case, but nevertheless there came out the traces of the remote antennas. In the satellite itself the same elements are visible which were discovered in the restored “Nadezhda-6”: the body of conical shape and antenna turned to the Earth. Below the picture with pointers to the elements is shown.



Elements of “Nadezhda-7”.

Here the photo from the Internet is given. This photo was taken by a mini - satellite “SNAP-1”, when it was detaching from the “Nadezhda-7”.

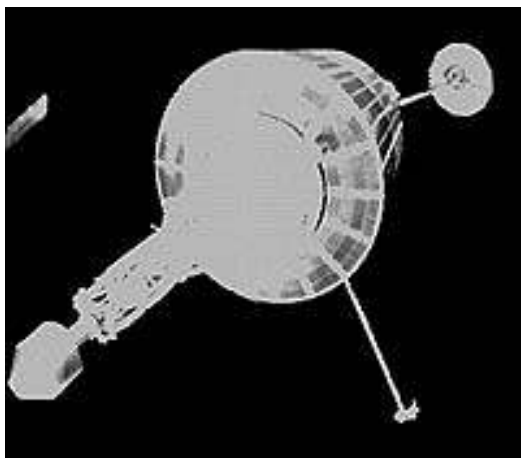
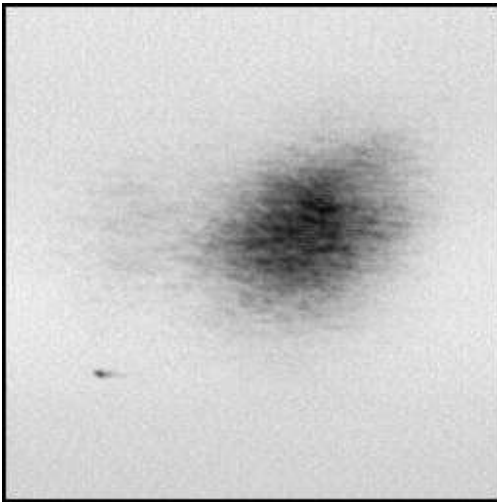


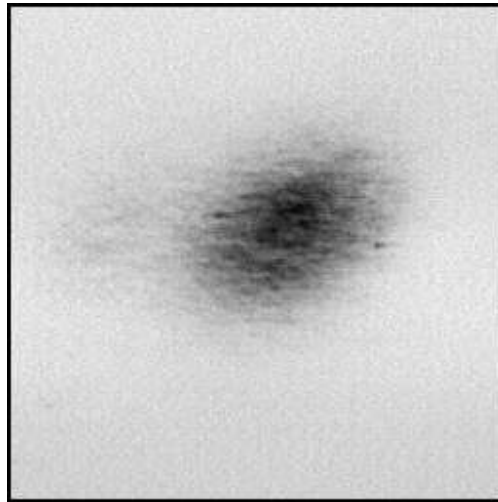
Photo of “Nadezhda-7” taken in cosmos.

The main elements of the satellite are visible at this photo: the conical body, the round antenna in the more narrow part of the body, the big bar from the opposite side of the body. Its trace came out in the restored image. It seems the remote elements visible in the restored image are attached to it.

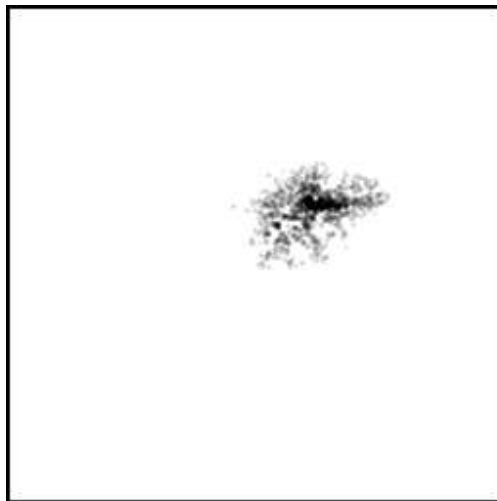
6. Restoration of ISS by 12 frames .



1-st frame of 12.



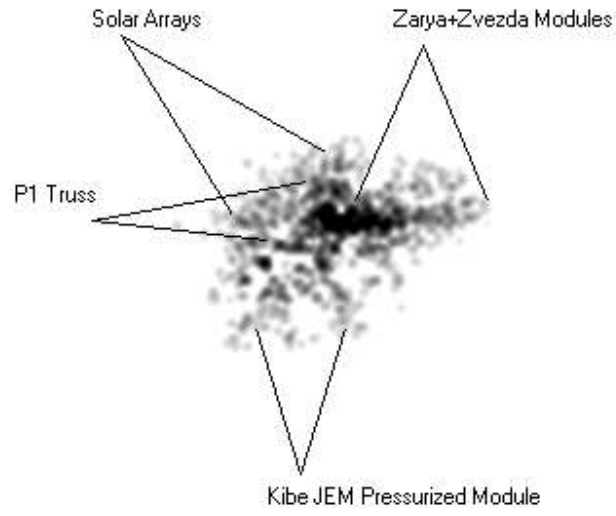
12-th frame of 12.



The restored image, 711 iteration.

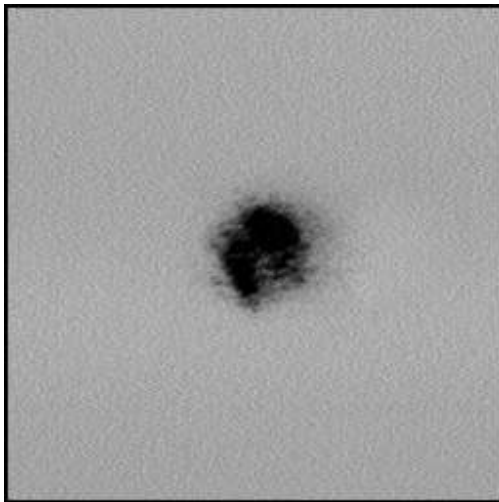
The modules “Zarya + Zvezda” are visible at the picture, the truss P1 is perpendicular to it, the big solar panel of the station is visible in the left part of picture. Under this panel a cylinder is visible at the American site of the station, which is perpendicular to the whole direction of the station and is parallel to the line of the truss. This position corresponds to location of the Japan experimental module.

In more details all these elements are visible and pointed in the image below enlarged 2 times:

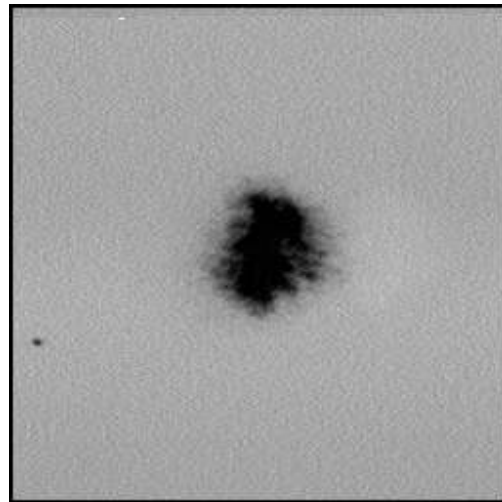


Restored image enlarged 2 times.

7. Restoration of KH -12 by 9 frames .



The 1st frame of 9



The 9th frame of 9 .



The image restored on 722-nd iteration.

Below the image enlarged two times is shown and some restored elements are pointed: 1) The body of the satellite with a round bottom, that becomes narrower to the bottom of the picture ; 2) a telescope, which is pulled out of the body and perpendicular to it ; 3) the solar panel (one of the two ones), which is also perpendicular to the body when telescope is working and performs two functions at once : a) accumulates the solar energy ; б) prevents the telescope from the straight sun light. The normal to the lens of a telescope is always perpendicular to the direction of the sun rays, that is optimal at photographing and prevents a lens from overexposing.

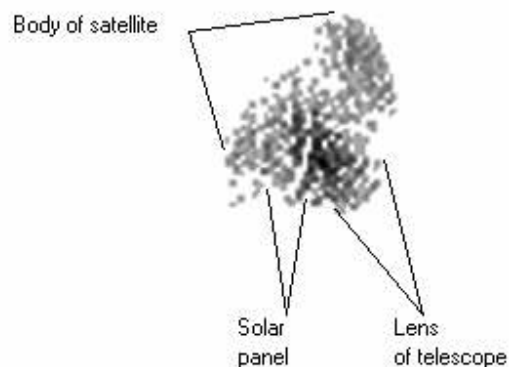
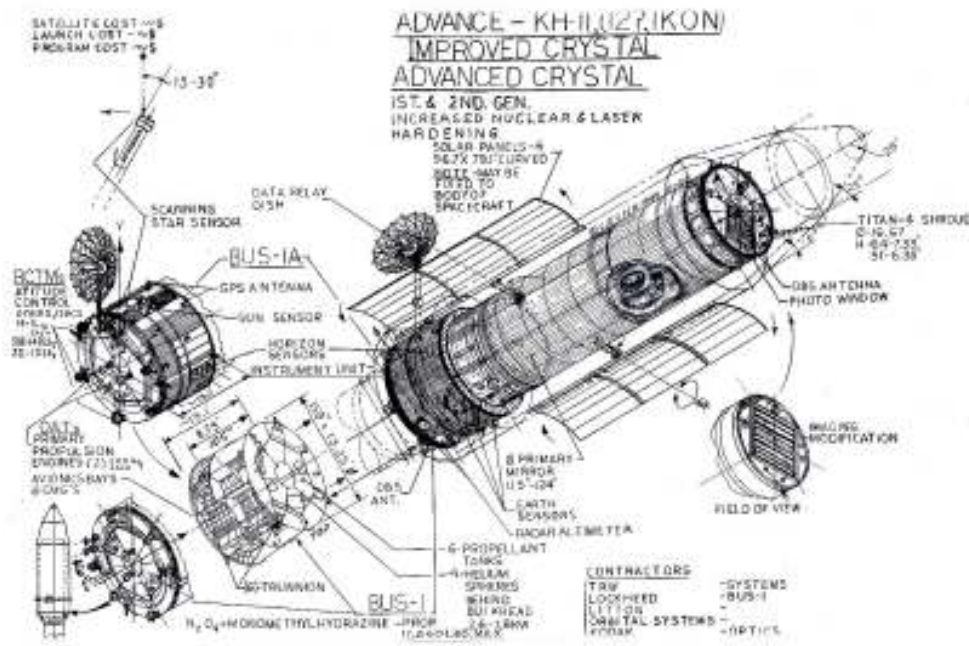


Image enlarged two times at 722 iteration.



A scheme of KH-12 taken from the Internet

It can be seen, that the lens is not pulled out of the telescope – it is installed into the body and the eye of the telescope looks to down. That is why the blend of the object -lens is never visible in the images. However in the restored image some construction perpendicular to the body and disposed under it is distinctly visible. It can be seen some oval at the bottom of it, possibly it is blend in this place.

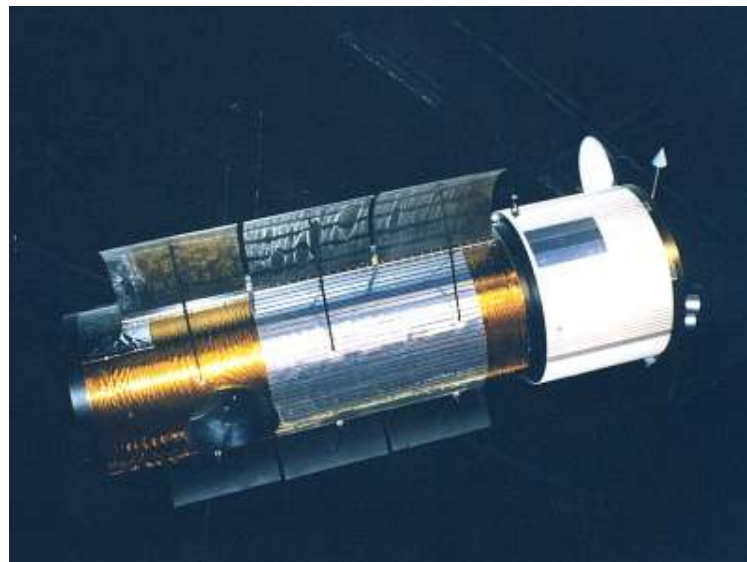
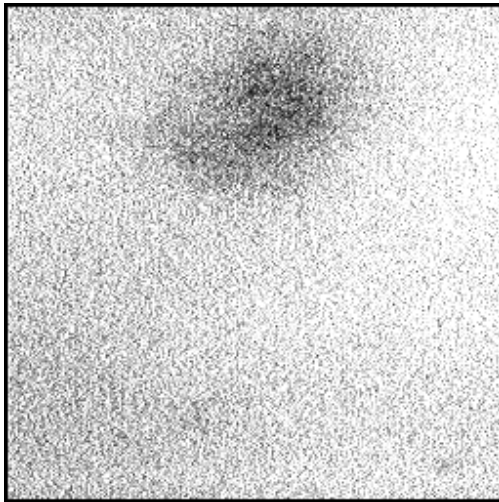
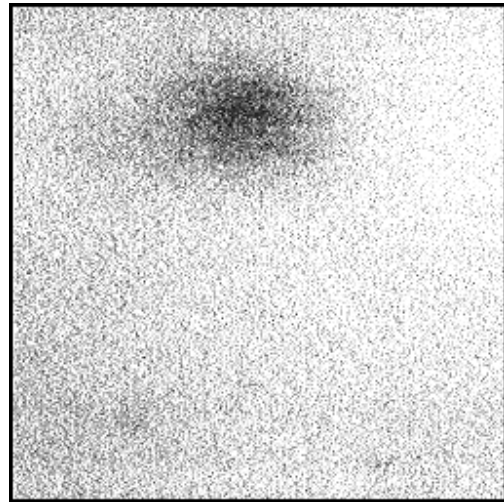


Photo of KH-12 from the Internet .

8. Restoration of the American satellite USA -144 by 10 frames .



The 1-st frame of 10.

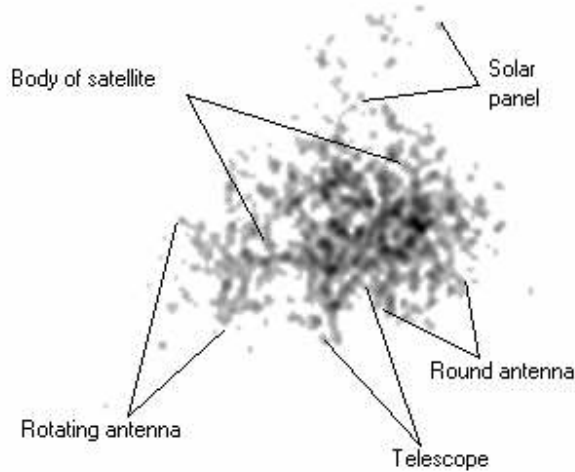


The 10th frame of 10.



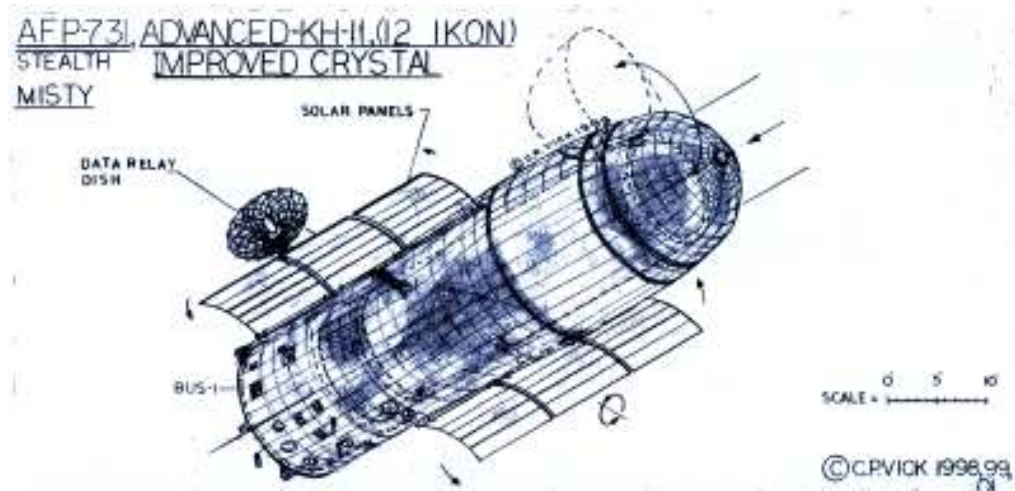
Restored image , 11-th frame.

In the restored image the next elements are visible: 1) a short and wide body of the satellite of the conical form with a round nose; 2) a solar panel over the body; 3) a telescope under the body similar to the telescope of KH-12; 4) an antenna having a form of a round plate under the body of satellite, that is directed to the Earth and similar to the analogous antennas in the other satellites "Nadezhda"; 5) a rotating antenna in a view of some rods, forming a star, disposed in the nose of the body. It is possible that because of this antenna the satellite was identified as a rotating object in some cases, though it hasn't to be rotating. These elements are shown in the image below enlarged two times.



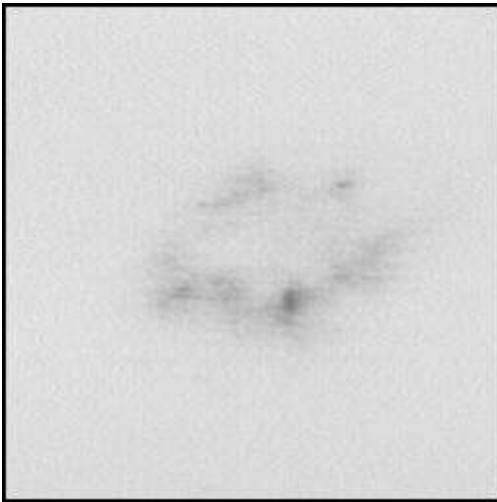
Restored image enlarged two times.

It looks like as if the prototype for USA- 144 was the satellite AFP-731 (1990-019B 20516 USA-53), the drawing of which is taken from the Internet and shown below.. The shape of the body in the restored image reveals a definite resemblance with AFP-731.

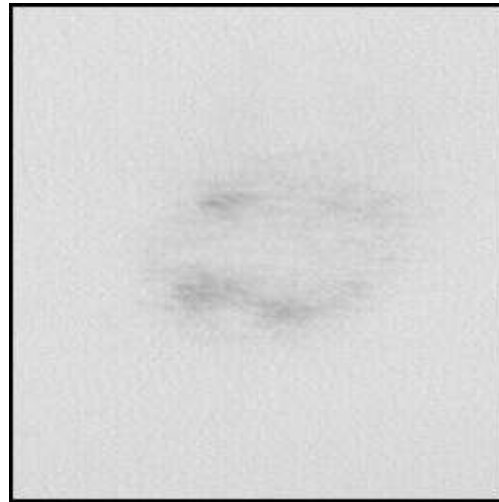


Scheme of the USA -144 prototype from the Internet (AFP-731).

9.Restoration of American satellite GLOBALSTAR by 11 frames.



The 1st frame of 11.

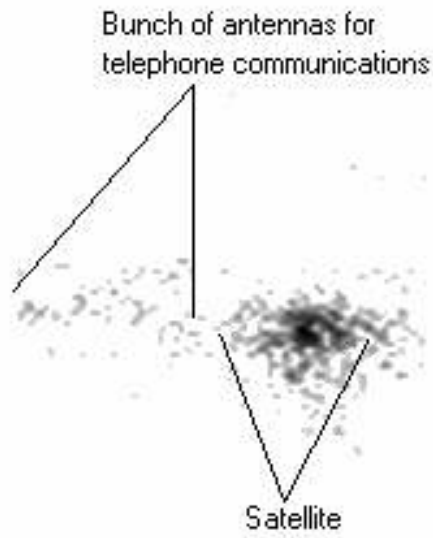


The 4th frame of 11 .



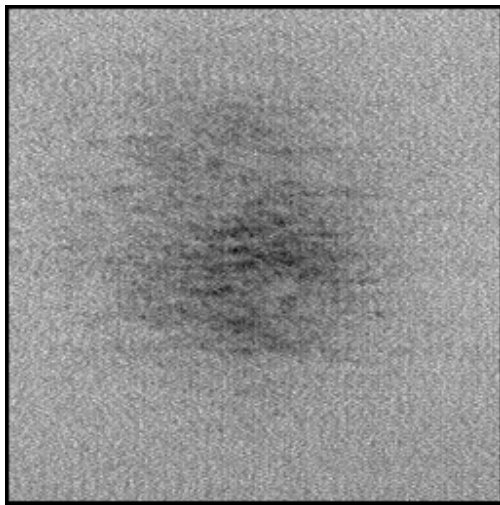
Restored image enlarged two times

It is American satellite “Global Star” for the telephone communications. In the restored image the satellite is placed on the right, its body is directed from the left to the right horizontally, the two rods come out the body and are perpendicular to it. From a tail of the satellite some constructions come out. Possibly it is a total combination of antennas for the telephone communications. There are traces of some antennas in the front part of the satellite. These details are pointed in the next picture.

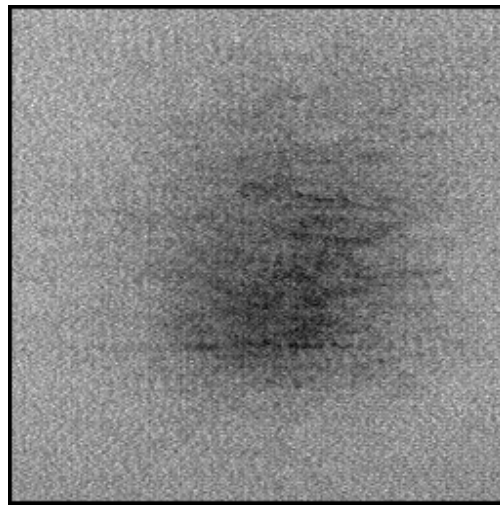


The more enlarged image.

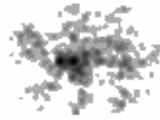
10. Restoration of the American satellite POSEIDON by 9 frames.



The 1-st frame of 9.

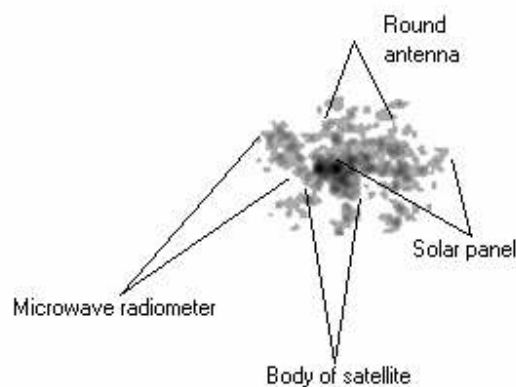


The 9-th frame of 9.



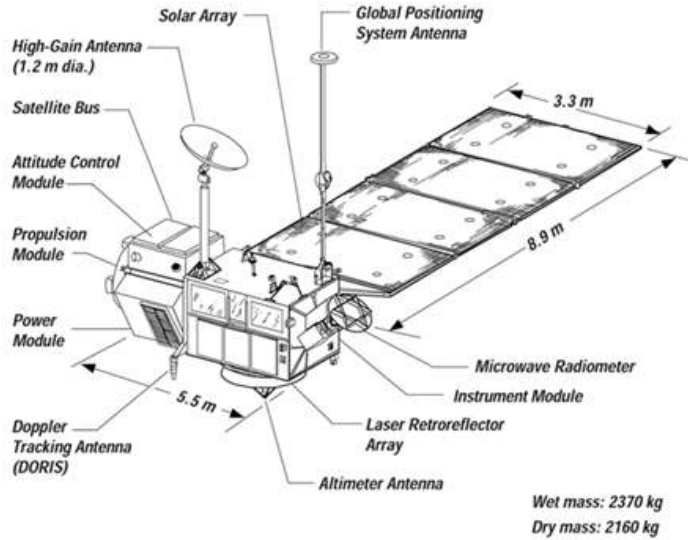
The restored image .

This is an American satellite “ Poseidon” for studying the properties and behavior of the ocean. There are visible the next elements in the satellite :1) a solar panel in the right part of the picture; 2) a device module , disposed on the left from the panel and perpendicular to it; 3) a round antenna over the satellite ; 4) a round antenna possibly of the microwave radiometer on the left in the image. These elements are pointed at the figure below, where it is shown the restored image enlarged 1.5 times. The resolution was low and comparable with dimensions of the main elements of the satellite (its sizes are equal $\sim 5\text{m} \times 1\text{m}$). Because of the low relation signal/noise in the input frames it appeared necessary to integrate the restored image over the every neighbor 4 pixels , and even two times. As a result, the resolution in the image fell four times more. So the details of the satellite came out not distinctly enough.



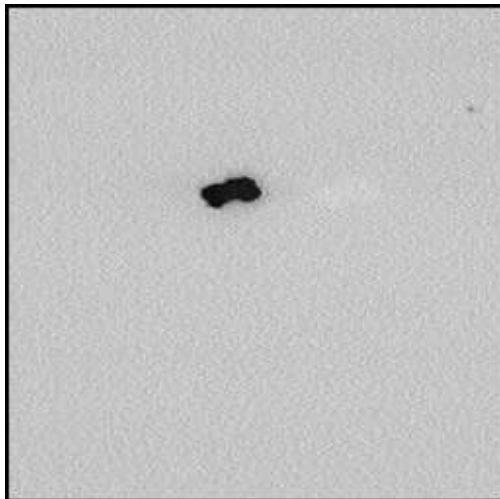
The image enlarged 1.5 times.

Nevertheless, in general a form of the satellite corresponds to the scheme given in the Internet and shown below in the picture.

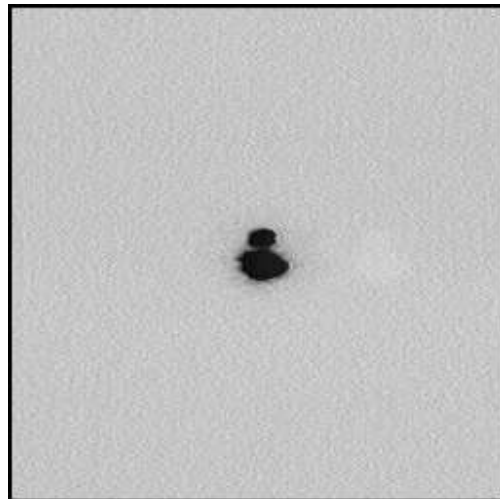


The scheme of “Poseidon” in the Internet.

11. Restoration of the satellite “Ferret” with 4 frames.



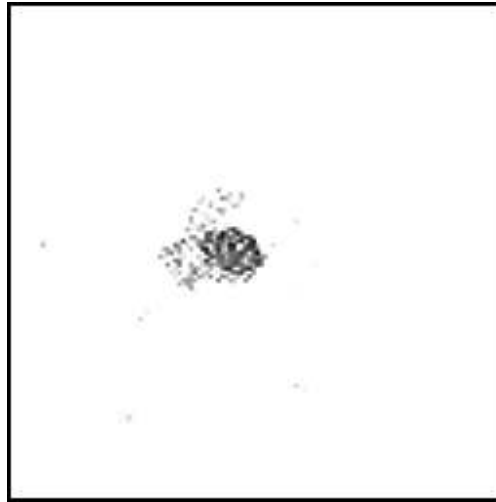
1-t frame of 4



4-th frame of 4

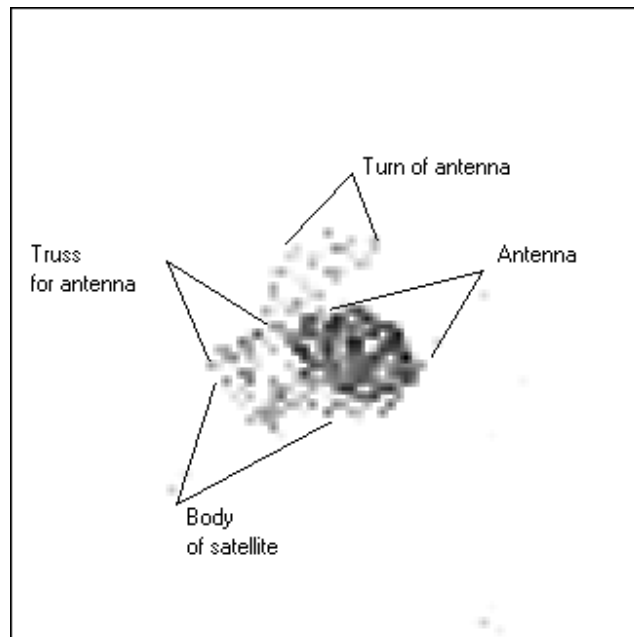
Below the image restored with these frames is shown. This result is received at 192-nd iteration. The restored image was twice enlarged and cut from the edges in the area of the empty space. A small narrow cylinder of the body is seen in the image from the left, some small bar

comes out from it upwards , and a round antenna of the satellite is attached to the bar (over the body and on the right from the bar).



Restored image enlarged two times.

Below the more enlarged image is given with pointing to the main elements .



The enlarging to 4 times

It can be seen from the restored image, that the satellite has three typical elements : 1) a round antenna turned to the Earth which detects the radar signals from it; 2) a body of the satellite in a form of cylinder ;3) a small bar, the antenna is attached to the body with which. It is known, that some part of the satellite “Ferret” is turning with a high velocity, that presents an obstacle to the restoration of its image. Here we used only 4 frames for the restoration with a whole time interval of observation equal to 0.160 sek. Besides an algorithm performs an operation of

superposing all the frames over their shift and turning (in the plane of frame), that gives an opportunity of the partial compensation of the object turning.

Nevertheless it can be seen the double image of the antenna, otherwise it is clear that the antenna was turning during the time interval taken for the restoration. It is need to note that the fact of multiplying some element in the satellite's restored image can serve as indication to the rotation of this element.

Conclusion.

The shown results confirm ability of the satellite images restoration when their original images received by telescopes are heavily blurred when pass through the atmosphere.

The row of satellites shows the same elements in their constructions. More often it can be observed at the shape of their antennas. So we can make conclusion that the antennas of some specific form are characteristic of the specific fulfilled function, and the same antennas appeared to be used in the satellites of the different purposes. And existence of the given type of antenna testifies that the satellite performs some certain operation possibly at the same time with the others. For example, antennas of the same type are discovered in the satellites "Nadezhda" and in the satellite of photo - recognition or in "Nadezhda" satellites and satellites of the radar imaging. It witnesses that their work principles are the same in a whole. The main distinction consists in the characteristics of their devices, their precision and resolution, but the functions performed by the different satellites (for example, monitoring the natural disasters or imaging of the important objects) appeared to be related and the sign of their performing is the presence of the specific elements in the construction of the satellite.

The less a noises level in the input frames and the better frames are superposed each to the others by turning and shifting an object in the frame the better restoration becomes. Shifting can be done easy by the correct cutting out an image from the whole field of observation. The second condition demands to reduce a time interval between the neighbor input frames, received by a telescope. It is strongly necessary if the object is rotating.