

## INTERACTIVE PROCESSING OF VENUS IMAGES

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Since 1975 the processing of Venus images from various spacecrafts is carried out in the Institute of Information Transmission Problems of the USSR Academy of Sciences. These are the first panoramic views of Venus surface (1) and photos of its clouds (2), panoramic views (3) from which first color images of this planet's surface were synthesized (4), and radio-location images (5).

To do this work we use the interactive image processing system of IITP. The self-made software of this system (6) consists not only of the wide range of interactive programs for image processing and analysis, but also a highly developed set of subroutines; the use of subroutines makes it very simple to realize all the new processing algorithms being necessary for any concrete aim.

Interactive mode of work dominates when processing Venus images. One of the main problems of their primary processing is, for example, line synchronization, i.e. the alignment of the first elements for all the lines. If the synchronization errors arise due to channel noise then we delete them by hand with the help of display processor (a special device for image storage, displaying and processing, which ensures the visual feedback between user and image). When working with radio-location images, where the cause of synchronization disturbances are changes in the locator height, it is the best of all to use bisquare approximation of these changes and to find approximation coefficients interactively. This procedure is performed with the help of buttons and joysticks so that the synchronization curve on the display processor screen reaches the middle of the black strip at the displayed image (this strip corresponds to the boundaries of location zone).

The dialogue between system and user was effectively used when removing the serial code errors and deleting the telemetry strips from the panoramic views. In the first case we were adding or deleting code bits with checking the corrections of view restoration on the screen. In the second case the interactive mode of

linear correction was used for the parts of the panorama by which the telemetry strips were replaced (such the correction was continued up to the absolute indistinguishability of parts' boundaries).

It is very attractive to use dialogue for superimposing two radio-location images after geometrical transform of one of them. The most convenient way of doing this is to store a fragment of base image and a fragment of transformed image into the memories of the display processor. By pressing functional buttons we can display on the screen any of these fragments and to move them up to the coincidence of their details (note that after each move the geometry of the transformed fragment alters because of the changes in transform parameters). Values of all the parameters which are useful for checking the correctness of superimposing are to be displayed together with fragments.

In some cases we use automatic methods of image processing. E.g., the correction of nonuniformity of antenna diagram for radio-location images and the contrast enhancement of panoramic views are made automatically with the help of fast linear filtering algorithms. Automatic mode is also used for median filtering of pulse noise at the panorams and for correction of multiplicative disturbances at the results of radio-location.

IITP's experience in Venus images processing shows that interactive methods are very effective in this case; they give possibility to reach very high quality of processed images without using large and expensive hardware.

#### References

1. Bockstein I., Chochia P., Kronrod M. e.a. (1979) In First Panoramic Views of Venus, p. 80-106. Science, Moscow.
2. Chochia P. e.a. (1978). Space Researches, v.16, n.6, p.877-885.
3. Bockstein I., Chochia P., Kronrod M. e.a. (1983) Space Researches, v.21, n. 2, p. 190-199.
4. Bockstein I., Chochia P., Kronrod M. e.a. (1983) Ibid, p.183-189.
5. Bockstein I., Chochia P., Kronrod M. e.a. (1985) Space Researches, v.23, n.2, p. 179-190.
6. Chochia P., Kronrod M. (1983) In Iconics: theory and methods of image processing, p. 87-99. Science, Moscow.