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Anomalies in Video Transmissions from Venera-13 Are Probably not Life Forms[1]

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Abstract—Some anomalies in the video images from Venera-13 are explained as possible artifacts of the telemetry system. One anomaly may be a shadow caused by a change in the distribution of illumination.

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A recent paper points out some anomalies in the video transmissions by Venera-13 from the surface of Venus, and it speculates about the possibility of high-temperature life forms (Ksanfomality, 2012). An alternative theory for the anomalies is proposed, based on characteristics of the radio telemetry system.

First, let us briefly review relevant aspects of the Venera-13 mission and systems. Nearing Venus, on February 28, 1982, the four-ton Venera-13 separated into a landing vehicle and a large flyby spacecraft. On March 1, they encountered the planet, and the lander set down at 03:57:21 UTC. Several minutes later, after drilling into the surface and performing mineral analysis, two panoramic cameras began to scan the surface though thick quartz windows. Sensitive photomultiplier tubes and an electronics unit generated a digital video signal (Selivanov et al., 1983a). On a 2-meter wavelength, the two videosignals were transmitted from the lander to the flyby spacecraft. The spacecraft re-modulated and beamed the signal to Earth via a high-gain parabolic antenna and stored it on magnetic tape (Vinitskii, 1993; Molotov, 2004).

As part of a redundant design, the video was relayed to Earth simultaneously by two different radio systems. On a 32-centimeter wavelength, the digital video from the lander was sent unchanged, using the scheme of pulse code modulation (PCM). That is, pixel values represented as binarynumbers were transmitted one bit at a time. Vertical scan lines of 252 pixels were encoded as 9 bits of brightness informationand a parity bit. Scanned at 0.82 seconds per line, this amounted to 3072 bits of data per second per camera.

At the same time, on a 5-centimeter wavelength, another radio unit sent the video using a pulse magnetron, representing the pixel valuesas variable time intervals between 25 kilowatt microwave impulses. In this scheme, the pixel data was sent six bits at a time, at 512 numbers per second. Pulse intervals represented values with an mth code, $m = 128$ (Molotov, 2004). Variously described as orthogonal, bi-orthogonal or bi-simplex, the exact nature of the coding is not publically known. This scheme of impulse transmission is known as pulse-position modulation (PPM) or in Russian as VIM (*Vremya-Impul'snaya Modulyatsiya*).

In addition, the video from the landers was recorded on a pair of EA-079 digital video tape recorders, and in later telemetry sessions, the video data was retransmitted to Earth. On both Venera-13 and 14, one of the tape recorders failed or behaved unreliably (Lavochkin Design Bureau, 2002). If these tape recorders were similar to those used in Venera-15, they may have used Nordstrom–Robinson error correction coding (Molotov, 2004).

Figure 1 shows a portion of unprocessed video, apparently sent by pulse-code modulation. It displays the typical characteristics of that modulation scheme, with single bit errors creating "salt & pepper" noise. Figure 2 shows the same portion of video in a peculiar transmission, which displays entirely different noise characteristics. The amount of noise in the peculiar signal is relatively unchanged up to the end of transmission, while the PCM signal becomes significantlymore noisy near the end. It is expected that some bit errors would occur in the meter-band PCM transmission from lander to spacecraft; and indeed, a small subset of the PCM-style "salt & pepper" noise is seen in the peculiar transmissions. Most of the noise in the PCM video mustoccur on the interplanetary radio link from spacecraft to Earth.

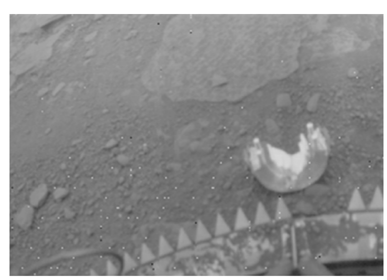

Fig. 1. Venera-13 video apparently sent by pulse-code modulation.

[1] The article is published in the original.

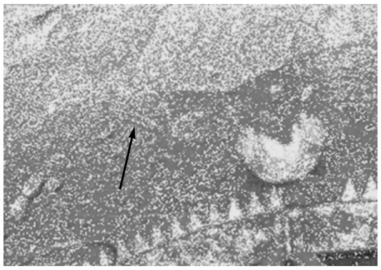

Fig. 2. Venera-13 video from a peculiar transmission. The black arrow indicates the "scorpion" feature.

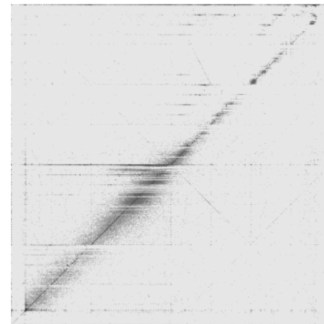

Fig. 3. Scatter plot of PCM (horizontal) vs. peculiar (vertical) pixel values.

In Dr. Ksanfomality's paper, one of the anomalous features was the "scorpion" shape, which is indicated by an arrow in Figure 2. However, this feature is completely absent from the PCM transmission in Figure 1.

To better understand how artifacts like "scorpion" might appear, Fig. 3 shows a log-intensity scatter plot of PCM vs. peculiar-signal pixel values for 3500 scan lines. Along the diagonal is the case of equal pixel values in both versions of the video. A horizontal distribution of points around the diagonal corresponds to bit errors in the pulse-code modulated video. However, noise in the peculiarsignal is less random and creates a geometrically patterned constellation of points. One consequence is that pixel errors in the peculiar transmission are related to image brightness. They can follow isophote curves of constant brightness, and thus produce some structures that catch the eye. In the case of "scorpion", there seems to be a row of rocks and pebbles that are being outlined by noise in the peculiar video, creating an illusion of body segments.

What is the origin of the peculiar transmission? One possibility is that they are the PPM transmissions. Errors in pulse-position demodulation are expected to produce small changes in the low-order bits of pixels; however, error-correction coding would be designed to widely separate those values. It is plausible that the geometric structure in this scatter plot is a result of such an unknown coding scheme. Another possibility is they are playbacks from the onboard digital tape recorders, with a possible malfunction of the coding and decoding of the stored data. Peculiar transmissions have been seen only for camera II of Venera-13 and camera I of Venera-14, which does not contradict thereported failure of one tape recorder on each spacecraft.

Another anomalous feature is a dark shape under the PrOP-V penetrometer, which Dr. Ksanfamalitynamed "black rag". This feature is seen early in the video transmission, but when the camera returns to the region in repeated scans, the dark feature is gone. Dynamic features caused by wind or possible corrosion of titanium parts have been discussed by the principal investigators of the Venera-13 mission (Selivanov et al., 1983b).

In the first released photographs of this region, there is an almost black feature on the near side of the penetrometer punch, which is located at the far end of the extended framework. The author has calculated a new camera response function for the Venera images,

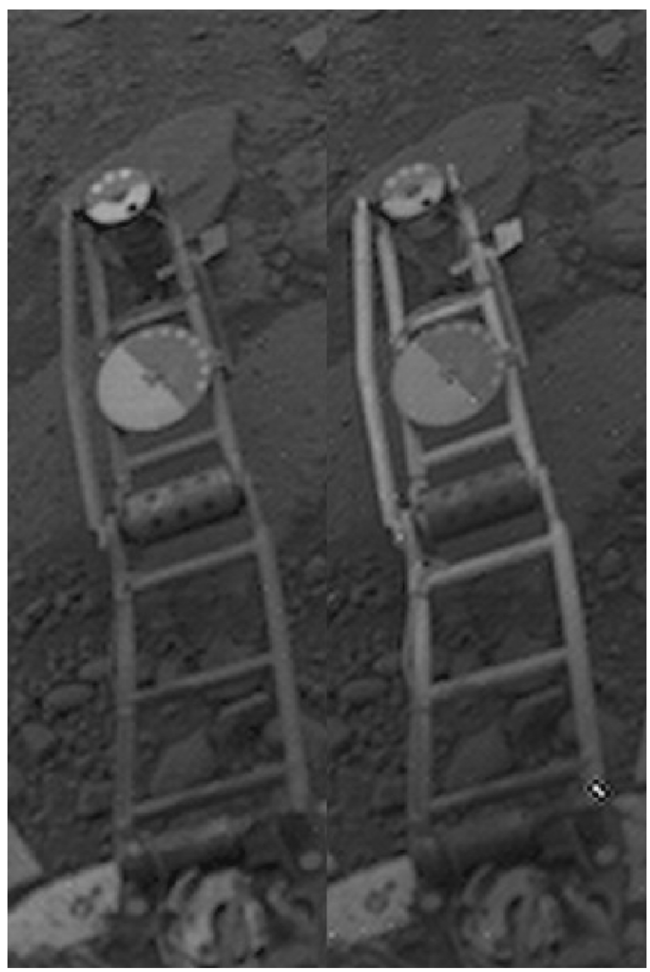

Fig. 4. Changing shadow under PrOP-V penetrometer.

using the photometric wedge signal from the camera and a technique for radiometric self-calibration (Mitsunaga and Nayar, 1999). In the author's versions of the photos, seen in Fig. 4, the so-called "black rag" appears to be a shadow, but it is absent in a view scanned 26 minutes later.

Why woulda shadow appear and then disappear. It is commonly assumed that the illumination on the surface of Venus comes from a uniform hemispherical glow, completely diffused by high altitude cloud layers and molecular scattering in the dense atmosphere. However, Grieger and Ignatiev recently discovered evidence for a near-surface cloud layer on Venus (Grieger, 2003). Is it possible that a low level cloud passing over the landing site created a temporary non-uniform distribution of illumination?

The idea of high-temperature life is intriguing, but the anomalies seen in the Venera-13 video probably have a more mundane explanation. Nevertheless, the controversy brings up new questions about the Venera data and about lighting conditions on Venus. Hopefully, this stimulates interest and a desire for future missions to Venus. The Soviet Union landed on Venus 10 times, but the last spacecraft to do so was in 1985.

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