

# Restoration of Old and Deteriorated Well-Loggings

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## Abstract

*In the oil industry (and not only here), for old rigs, an important volume of classical loggings are still kept and used. This information can be digitized in order to be further processed. A number of software products deal with this digitization. One of the problems is the sometimes poor quality of the old loggings (some of them more than 50 years old). The paper presents some techniques used to improve the quality of the scanned loggings, as a prerequisite for a successful digitization. The main idea is to isolate the curves and the gridlines, process these images separately and then reunite them again, in an improved RGB image. The processing consists in a succession of morphological operations performed on the curves and gridlines images.*

**Keywords:** digital restoration, logging, pre-vectorization

## The context

Even if for some years loggings are obtained using digital technology, large amounts of data is still on paper support. One speaks about old and very old loggings for wells still active. A very time consuming problem is to make the digitization of the old loggings. This is done using different software packages and the process can be summarized by the following plot:



**Figure 1:** Logging digitization

Since the old loggings are really old (20, 30, 40 years and even more) a very important issue is the quality of the logging. Very often, the curves and the grid lines are merely visible, the background is full of noise etc. These aspects make the digitization process difficult and demand a lot of human operator intervention. The purpose of the paper is to devise a method to

process the old loggings in order to improve their quality and as a result to ease the very process of digitization.

## Related work

The general image restoration topic is well supported with papers or books. The theoretical work is continuously evolving, while the practical work is applied on a number of specific cases, starting from old and deteriorated photos, or medical imagery, up to astronomy images.

The very specific case of old, and very often, deteriorated logging is poorly documented. Maybe because the problem is of a narrow interest (reduced mainly to the oil industry).

The work of Li, Zhang, Wang and Song focuses on an agent based approach, but with an emphasis on the process of vectorization, and not on the pre-processing of the scanned logs with the intent of augmenting the chances of a good vectorization [1]. The above mentioned authors' work also deals with the management and storage of the well-loggings graphs

## General approach

The general approach that has been chosen is to work in three steps:

1. Isolate and process the curves
2. Isolate and process the grid lines
3. Superimpose the two improved images

The improved curves image is a black and white one, while the improved grid image is a RGB image. It is obvious that the final image, obtained through the superimposing of the two preceding ones, will be a RGB image [2][5], in order to assure a maximal resemblance with the original image.

## Isolating and processing the curves

### The main idea

The idea behind isolating the curves is simple: one starts from a tiff image and one simply makes the pixels with colors identified as belonging to the grid lines and background, white (value 255).

Figure 2 presents the original tiff image and the bw curves image (the initial result is still a RGB image). The block diagram of the curves extraction is presented in Figure 3.

The outcome has been reached by using a simple Matlab m file [5][8]. The images presented in Figure 2 are only portions of the initial logging and isolated curves image respectively (for space purposes). The final result is presented in Figure 4.

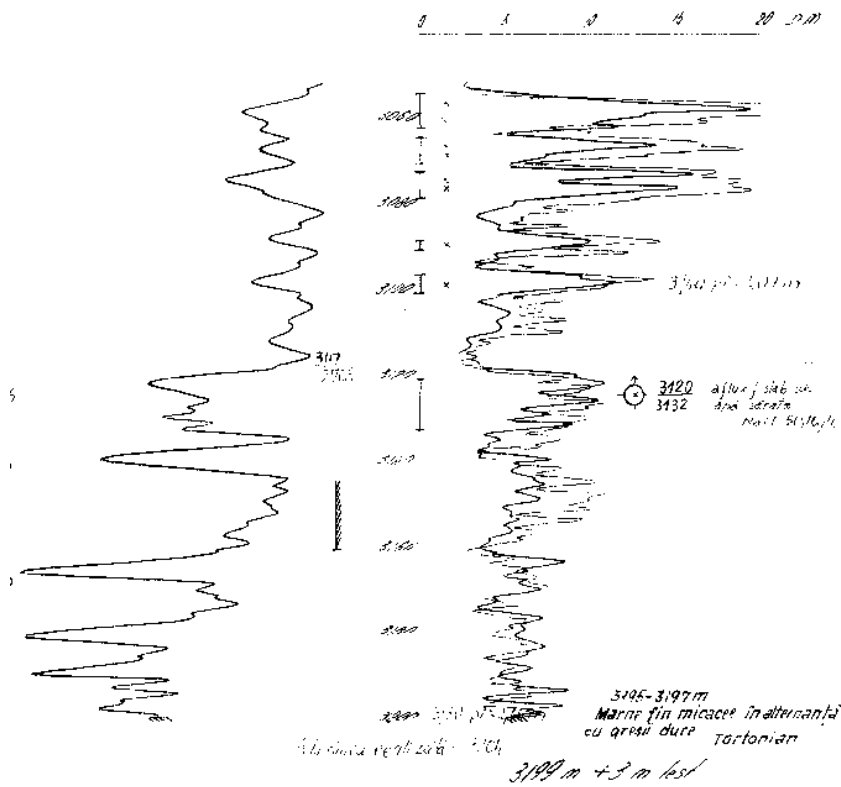
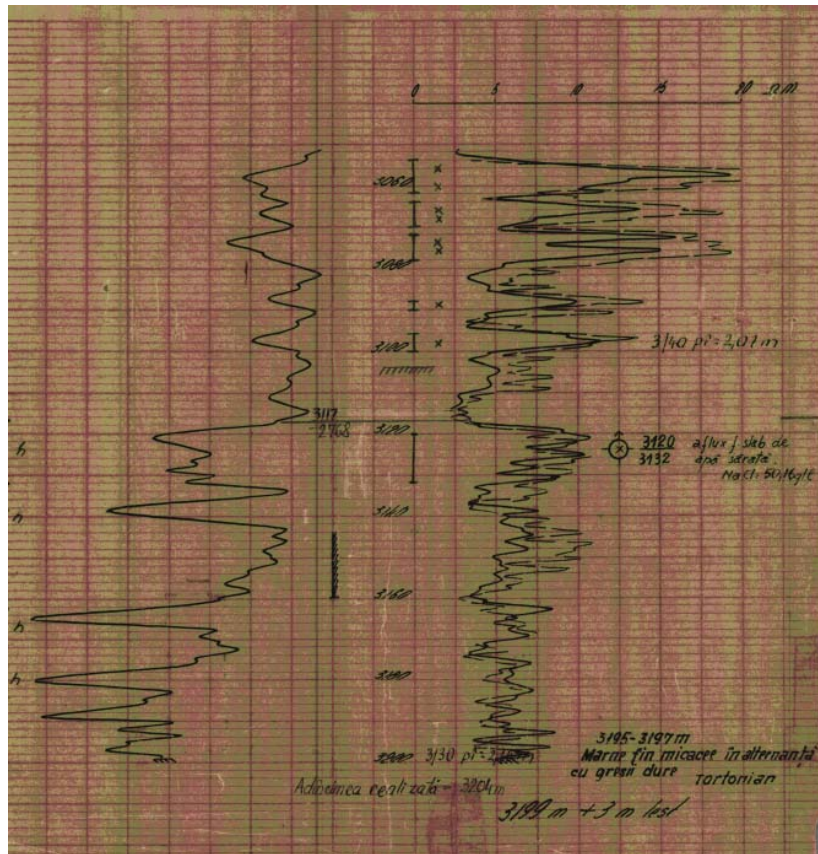


Figure 2: Old logging and isolated black/white curves image

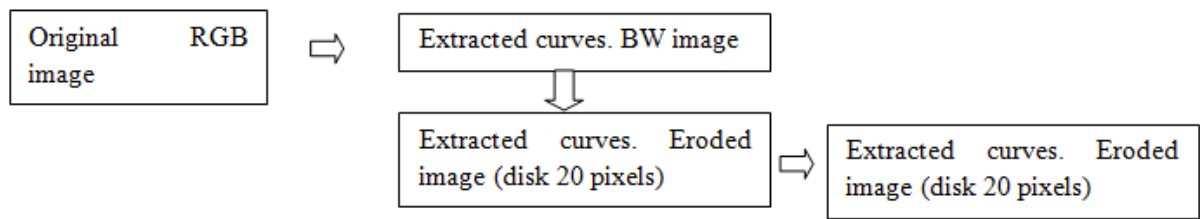


Figure 3: The block diagram of the isolation and processing of the curves

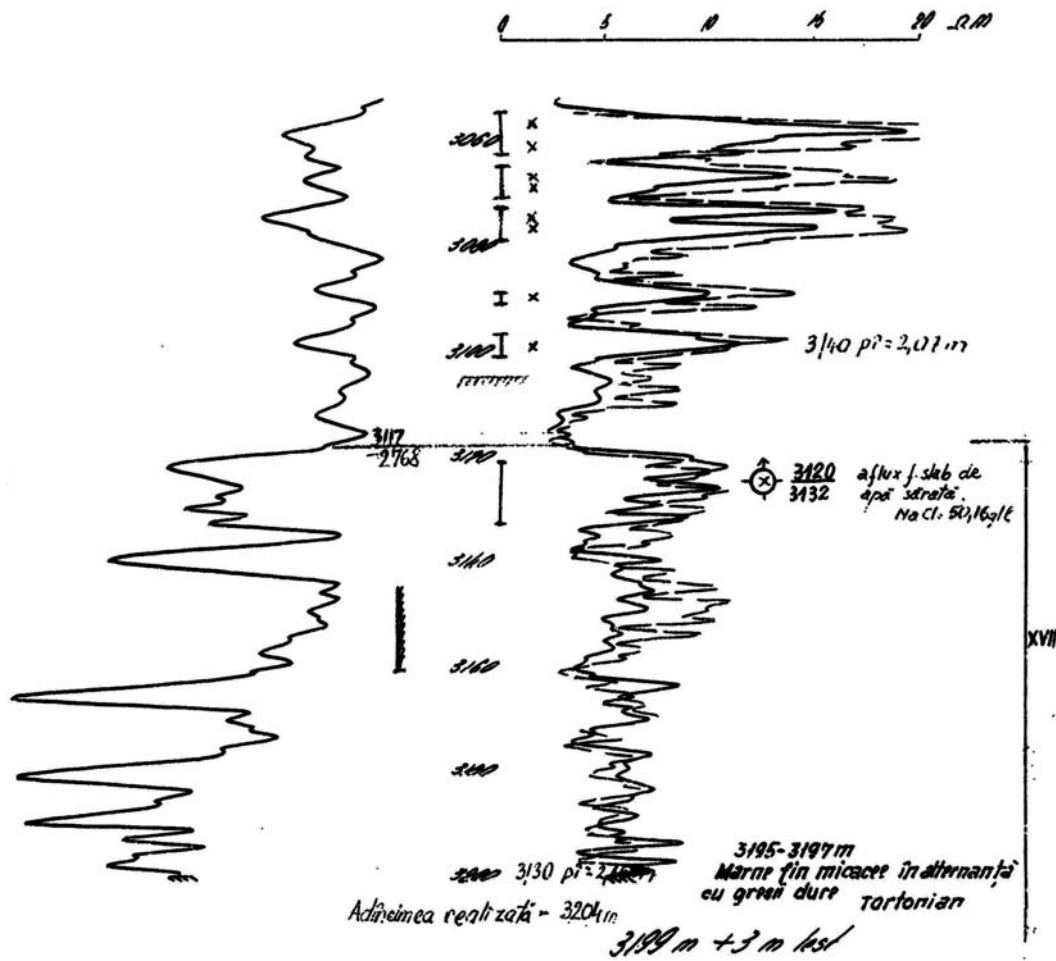


Figure 4: The final dilated and eroded curves image

Figure 5 presents two zones extracted from the three stages of the image: original tiff image, black-white extracted curves image and finally the processed twice eroded image.

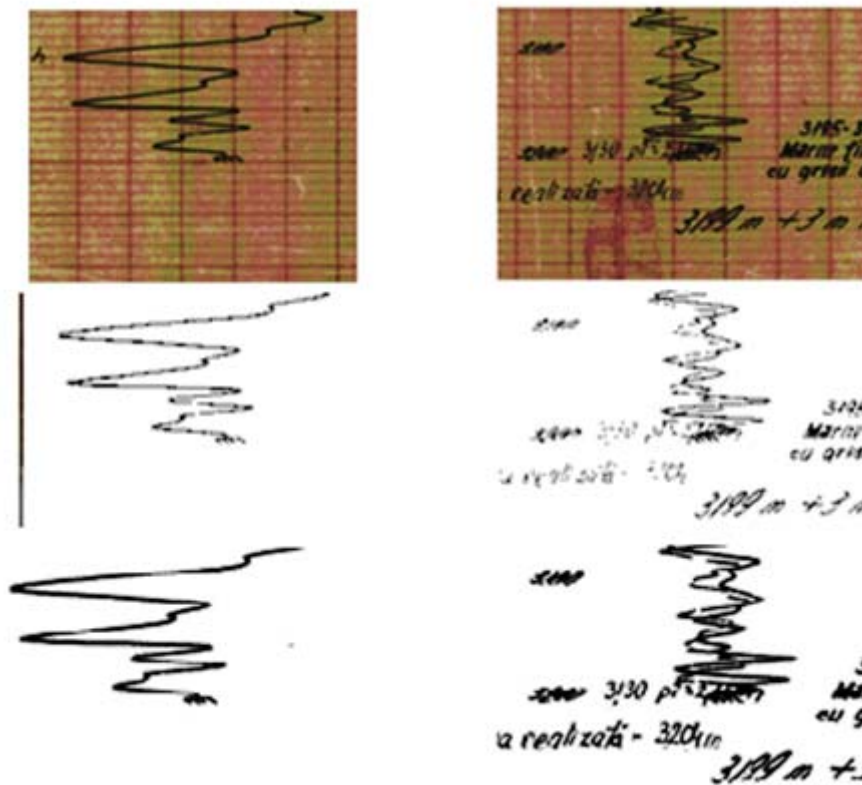


Figure 5: Comparing tow zones of the three stage images

### Isolating and processing the gridlines

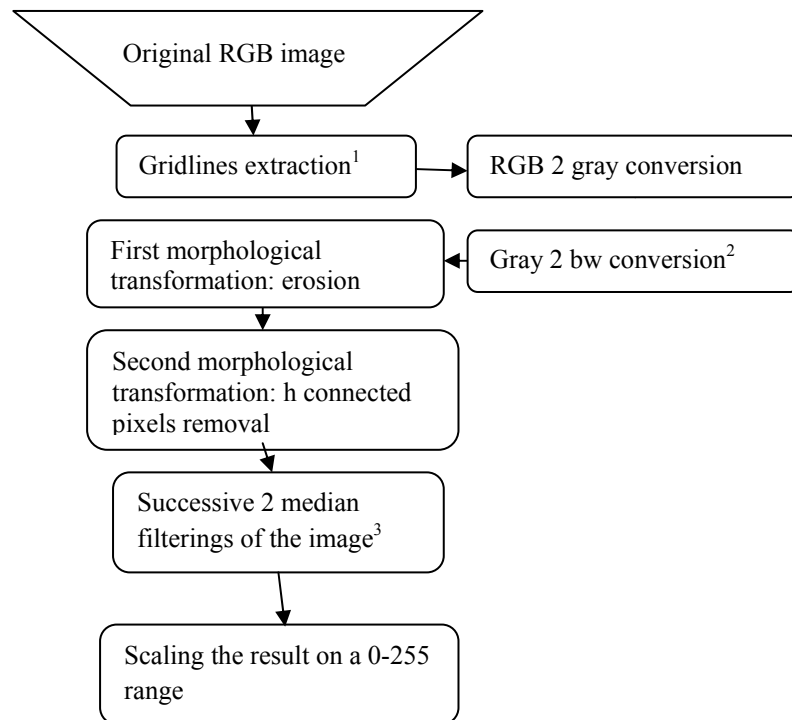
The problem of the grid lines is a little bit more complicated since on the old (initial) logging the grid lines are more deteriorated than the curves themselves [2][5][6].

The block diagram that describes the gridlines extraction is presented in Figure 6.

### Superimposing the two improved images

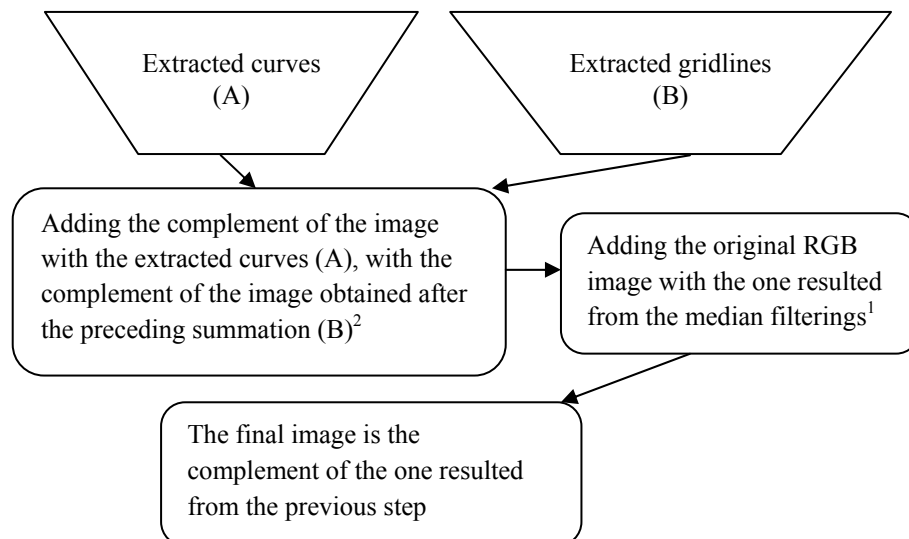
At that stage, we have two images, one with the extracted curves, and the other one with the extracted gridlines. Both have been processed in order to improve their quality [3] [4] [6].

The final stage of the process is the superimposing of the two images. This will be done following a block diagram presented in Figure 7.



1. The gridlines are extracted by eliminating the pixels colored otherwise than the gridlines themselves (the process is similar with the one used in isolating the curves)
2. The threshold for the gray2bw conversion is determined by the function *graythresh*.
3. The first median filter uses a 5x5 neighborhood, while the second filtering is done with a 3x3 neighborhood [6].

**Figure 6:** The block diagram of the isolation and processing of the gridlines



1. The adding of the two images is possible due to some data type conversions.
2. Again, some data types had to be performed in order to make the addition

**Figure 7:** The block diagram of the superimposing of the extracted curves and gridlines

The result of this complex process is presented in Figure 7, where the two images have been merged. Please compare this image with the one presented in Figure 1.

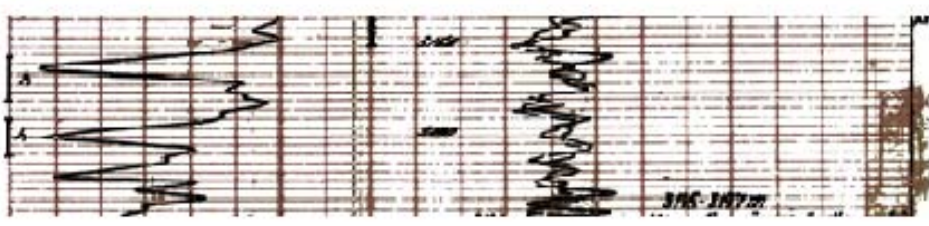
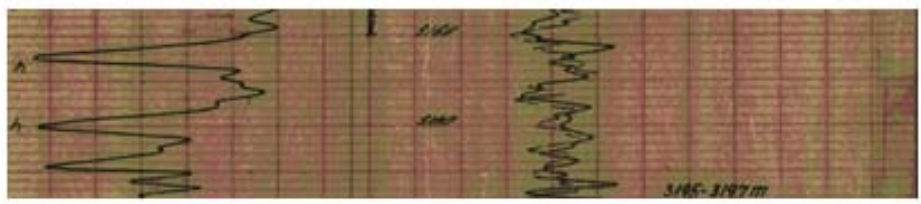
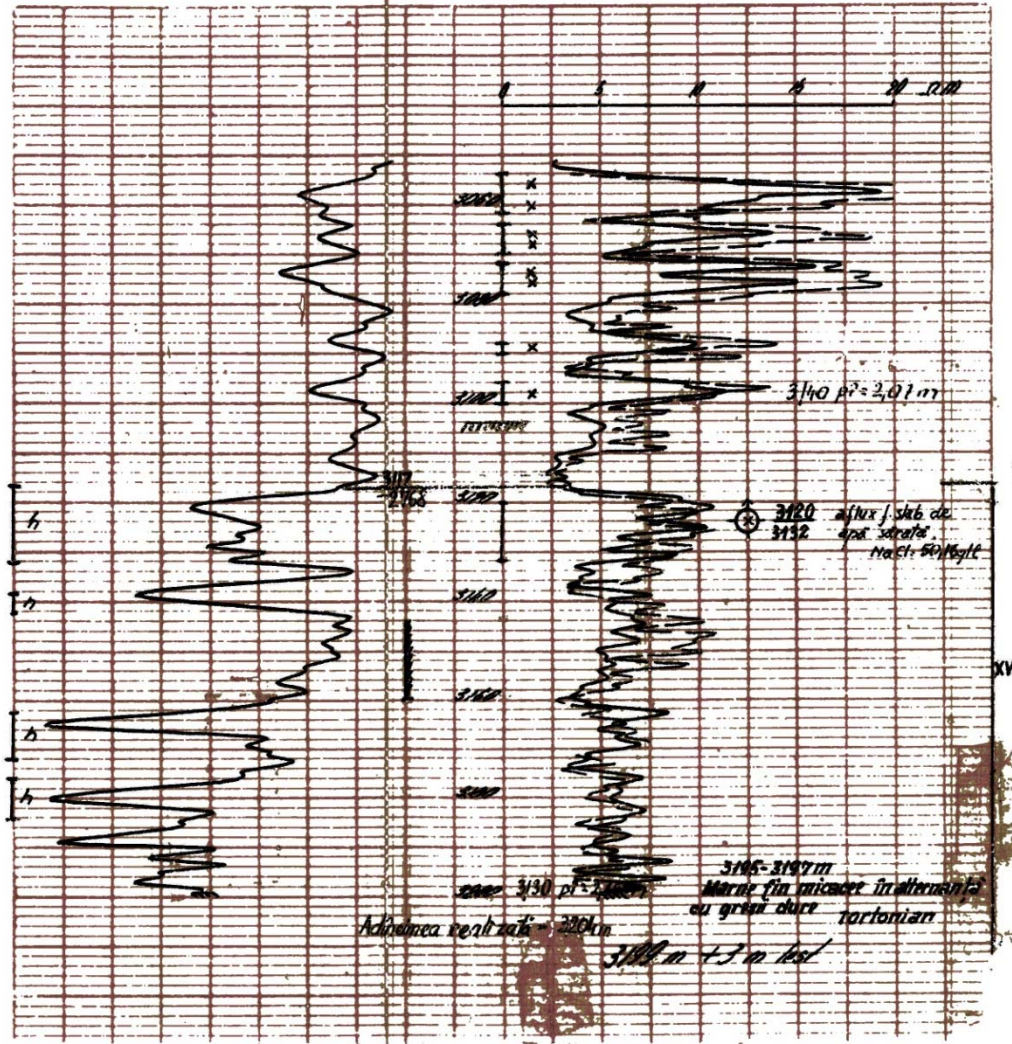


Figure 8: The final image

## Conclusions

The process of improving the quality of the old scanner loggings is quite complex and its success is in direct relation with the initial state of the loggings.

The method implies the human operator intervention in selecting (choosing) the colors to be eliminated from the scanned loggings.

The quality of the final image is quite good in comparison with the initial loggings and assures a more quick and precise digitization of the scanned loggings.

The method is quick and improves the productivity for the digitization process that will follow.

The effectiveness of the method has been proved during a research contract that was dealing with the very process of digitization of old (20 to 40 years old) and deteriorated loggings.

Possible further developments could be defining a standalone application to be run without Matlab. This will assure the portability of the application.

Another possible development would be the automate detection of the colors of the gridlines and curves, using template images. The result of this process would be elimination of the human operator intervention in the process.

## References

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# Restaurarea diagrafiilor vechi și deteriorate

## Rezumat

În industria de petrol (și nu numai), pentru instalațiile vechi, un volum important de diagrame clasice sunt încă păstrate și folosite. Aceste informații pot fi digitizate pentru a fi prelucrate ulterior. O serie de produse software fac această digitalizare. Una dintre probleme este calitatea uneori slabă a diagrafiilor vechi (unele dintre ele cu vechimi mai mari de 50 de ani). Lucrarea prezintă câteva tehnici utilizate pentru a îmbunătăți calitatea diagrafiilor scanate, ca o condiție prealabilă pentru o digitalizare de succes. Tactica adoptată a fost de separare a curbilor și respectiv caroiajelor, în două imagini distincte, care sunt prelucrate separat, cu o succesiune de operații morfologice. La final, cele două imagini îmbunătățite sunt „reunite” într-o imagine finală RGB.