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DETECTION OF SOLAR PANEL SURFACE DAMAGE USING AN IMAGE PROCESSING ALGORITHM

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Solar panel surfaces can be damaged by falling small stones, hail, and cracks due to uneven temperature distribution. The presence of damage on the surface of a solar panel leads to a decrease in the amount of solar energy directly falling on the photocells, and, consequently, to a decrease in the power generation of this panel [1].

The developed by authors algorithm for processing the panel image [2] can be used to detect damage to solar panels. The algorithm includes the calculation of the difference between the clean panel image and the dusted panel image and than the calculation of sum of brightnesses of all pixels of this image. This sum of brightnesses can be used for making a decision of a pane cleaning start.

The effect of damage to the surface of a solar panel on its efficiency is similar to the effect of surface contamination. Therefore, by assessing the value of the total brightness of the difference image after cleaning the panel, it is possible to determine the presence and extent of damage. If there is damage on the surface of the panel, as shown in Figure 1, then after cleaning the panel from dust, the value of the total brightness of the difference image can be quite large, which indicates the presence of damage.

a b

Figure 1. Undamaged (a) and damaged (b) solar panels images

The image of the difference between images of the undamaged and damaged panels is shown on the Figure 2.

Artificial lighting was used to ensure a constant level of illumination. The experiment was repeated and photographs were taken of undamaged and damaged panels at dust levels of 10, 20, 30 and 40 g/m².

Figure 3 shows the dependence of overall brightness and brightness in color channels of the different image for the undamaged (a) and damaged (b) panels on the dust density.

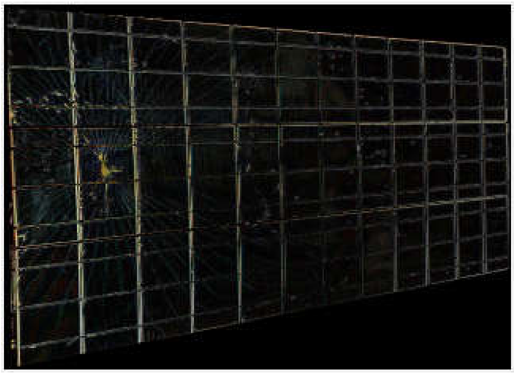
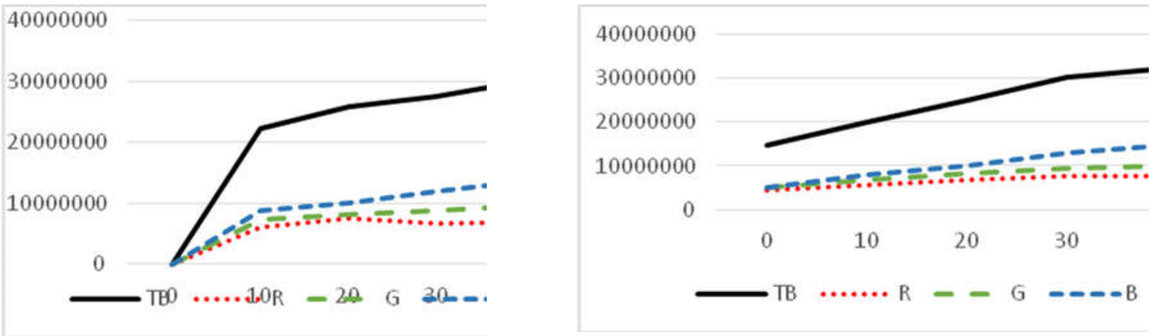


Figure 2 – The image of the difference of images the damaged and the undamaged panels.



a b

Figure 3 – Dependences of the values of the total brightness and brightness in the color channels on the dust density on the surface of the solar panel for the undamaged (a) and damaged (b) panels.

Conclusion

1.Total brightness of the difference image of a solar panel can be used to detect damaged panels.

2.The condition of the panel (damaged vs. intact) significantly alters its baseline reflectance and its response to dust.

References

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2. Albagoush A.A. Analysis of the operation of the algorithm for processing the image of a solar panel to assess its dustiness. «System analysis and applied information science». 2025;(1):32-36. https://doi.org/10.21122/2309-4923-2025-1-32-36