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Enhancing the Bionic Eye: A Real-time Image Optimization Framework to Encode Color and Spatial Information Into Retinal Prostheses

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Abstract : Retinal prostheses are currently limited to low resolution grayscale images that lack color and spatial information. This study develops a novel real-time image optimization framework and tools to encode maximum information to the prostheses which are constrained by the number of electrodes. One key idea is to localize main objects in images while reducing unnecessary background noise through region-contrast saliency maps. A novel color depth mapping technique was developed through MiniBatchKmeans clustering and color space selection. The resulting image was downsampled using bicubic interpolation to reduce image size while preserving color quality. In comparison to current schemes, the proposed framework demonstrated better visual quality in tested images. The use of the region-contrast saliency map showed improvements in efficacy up to 30%. Finally, the computational speed of this algorithm is less than 380 ms on tested cases, making real-time retinal prostheses feasible.

Keywords : retinal implants, virtual processing unit, computer vision, saliency maps, color quantization
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