DIP Assignment

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Project Topic 1: Underwater Image Enhancement Using Adaptive Retinal Mechanisms

Abstract— We propose an underwater image enhancement model inspired by the morphology and function of the teleost fish retina. We aim to solve the problems of underwater image degradation raised by the blurring and nonuniform color biasing. In particular, the feedback from color-sensitive horizontal cells to cones and a red channel compensation are used to correct the nonuniform color bias. The center-surround opponent mechanism of the bipolar cells and the feedback from amacrine cells to interplexiform cells then to horizontal cells serve to enhance the edges and contrasts of the output image. The ganglion cells with color-opponent mechanism are used for color enhancement and color correction. Finally, we adopt a luminance-based fusion strategy to reconstruct the enhanced image from the outputs of ON and OFF pathways of fish retina. Our model utilizes the global statistics (i.e., image contrast) to automatically guide the design of each low-level filter, which realizes the self-adaption of the main parameters. Extensive qualitative and quantitative evaluations on various underwater scenes validate the competitive performance of our technique. Our model also significantly improves the accuracy of transmission map estimation and local feature point matching using the underwater image. Our method is a single image approach that does not require the specialized prior about the underwater condition or scene structure.

Project Topic 2: Point Cloud Saliency Detection by Local and Global Feature Fusion

Inspired by the characteristics of the human visual system, a novel method is proposed for detecting the visually salient regions on 3D point clouds. First, the local distinctness of each point is evaluated based on the difference with its local surroundings. Then, the point cloud is decomposed into small clusters, and the initial global rarity value of each cluster is calculated; a random walk ranking method is then used to introduce cluster-level global rarity refinement to each point in all the clusters. Finally, an optimization framework is proposed to integrate both the local distinctness and the global rarity values to obtain the final saliency detection result of the point cloud. We compare the proposed method with several relevant algorithms and apply it to some computer graphics applications, such as interest point detection, viewpoint selection, and mesh simplification. The experimental results demonstrate the superior performance of the proposed method.