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成像技术与图像处理

基于小波加权的激光干扰效果评估

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摘要：光电成像系统是一种被广泛应用的观测工具,可以用来实现图像的探测、识别和跟踪等多种功能。激光干扰会造成光电系统成像元件的饱和或损伤,影响成像效果。为了解激光干扰对光电成像系统的影响程度,研究干扰图像质量评价具有重要意义。提出一种基于小波加权的结构相似度图像质量评价(WWSSIM)算法,该算法首先将原始图像和降质图像分别进行四级二维小波变换,划分成为具有不同尺度和不同频率特征的子带图像,在13个频带比较结构相似度,然后根据人类视觉系统特性,赋予13个频带的结构相似度以相应视觉权重值,最后通过求和平均得到归一化的图像质量评价指标。为了方便对比,分别运用均方误差(MSE)、峰值信噪比(PSNR)和结构相似度评价算法(SSIM)对Live数据库图像和激光干扰图像进行评价。结果表明,与PSNR算法相比,提出的WWSSIM算法在准确率上提高了5.2%,在一致性上提高了4.1%,与SSIM算法相比,提出的WWSSIM算法在准确率上提高了2.9%,在一致性上提高了2.6%。以上结果说明提出的WWSSIM算法相对于MSE、PSNR和SSIM算法评价结果更加准确,同时它对激光干扰图像的失真程度能给出更符合人类主观视觉感受的判断。

关键词：激光干扰 人类视觉系统 小波变换 图像质量评价 结构相似度

Assessment of Laser-Dazzling Effects Based on Weighted Wavelet Transforms

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Abstract: Photoelectric imaging systems are widespread observation tools used to fulfill various functions such as detection, recognition, and video-tracking. Laser countermeasures against imaging systems aim to saturate or damage the full camera image. In order to evaluate the dazzling effects of the laser and avoid such a disturbance, evaluation of laser-induced effects must be better understood. This paper propose a new algorithm composed of weighted wavelet structural similarity (WWSSIM), based on wavelet transforms and HVS property. Four-level 2D wavelet decomposition is performed for the original and disturbed images, respectively. Each image can be partitioned into one low-frequency subband and a series of octave high-pass subbands. Different subbands are processed with different weighting factors. Based on the results of the above, we can construct a modified WWSSIM. Comparison experiments show that the prediction accuracy and consistency of the proposed metric are respectively 5.2% and 4.1% higher than the PSNR index. The prediction accuracy and consistency of the proposed metric are respectively 2.9% and 2.6% higher than the SSIM index. In terms of experiment results, the new algorithm shows good feasibility comparing with MSE, PSNR and SSIM methods. WWSSIM is efficacious to reflect the laser dazzling effect.

Keywords: laser countermeasure human visual system wavelet transform image quality assessment structural similarity

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