J Laser Opt Photonics 2018, Volume 5
DOI: 10.4172/2469-410X-C5-036

International Conference on
PHOTONICS, OPTOELECTRONICS AND DISPLAY DEVICES
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International Conference on VEHICLE FIBER-OPTICS AND PHOTONICS
September 19-20, 2018 | Philadelphia, USA

A high-speed imaging method based on compressive sensing for sound extraction using a low-speed camera

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An efficient variance-based method to recover the sound information from ray-value variations chosen from speckle patterns captured by a high-speed camera, which reduces the computation time greatly. In order to reduce the price of a high-speed imaging device, we reported an efficient method for sound extraction from high-speed videos reconstructed from the coded images captured with a low-speed camera based on compressive sensing. Finally, we performed primary research on sound detection based on photon counting technique. The main results of our work are: (1) A speckle pattern processing method is proposed based on the pixel gray value variance to extract sound information. It extracts sound information directly from the gray-value of some specific pixels selected with variance criteria, resulting in fast computation. Only a few numbers of the first recorded speckle patterns are used for selecting the specific pixels. It is more robust to the quality of the speckle patterns and works well even if the speckle patterns are weak. Owing to the large dynamic range of the pixel's gray value, the variance-based method has higher accuracy. (2) An efficient method for sound extraction is proposed from high-speed videos reconstructed from the coded low-speed video captured with a low-speed camera based on compressive sensing (CS). This makes the high-speed video available with the traditional low-speed camera. (3) Sound detection based on a photon counting photomultiplier tube (PMT) is studied. The improved signal-to-noise ratio (SNR) of the recovered sound signal with a longer counter gate time, but the bandwidth of the detector is reduced. Through simulations, sound detection at a longer distance can be obtained with a less optical power..

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