散斑结构照明内窥镜

DOI: 10.12086/oee.2024.241004.h02

在内窥镜成像中，由于内窥镜成像的性质以及成像和探索的样本，需要非常宽的宽视场 (FOV) 和非常大的大景深 (DOF)。因此，探索在宽视场和大景深的内窥镜图像中实现超分辨率引起了人们的极大兴趣。

美国加州大学圣地亚哥分校的刘照伟教授研究团队提出并演示了一种散斑结构照明内窥镜 (SSIE) 的新方法，用于在内窥镜检查过程中实现超分辨率成像。他们在标准白光内窥镜 (WLE) 中引入了两根光纤，以提供高分辨率散斑来照亮物体。随机散斑图案是由两根光纤发出的激光之间相互干涉产生的。WLE 相机采集了许多具有标准分辨率的图像，然后进行图像重建以产生单个超分辨率图像。该研究通过对光学光源的改造获得宽视场、大景深，以及超分辨率，即多模光纤在一定方向上携带来自激光的随机照明图案，不仅覆盖了宽视场和大景深，而且在照明光束之间产生了大角度干涉，从而实现了超分辨率成像。该研究对平面和非平面表面进行了检验，以证明 SSIE 的目标是在大景深范围内进行成像。此外，也从理论角度进行了探讨，视场和自由度可以扩展到 WLE 允许的最大值。此外，SSIE 不需要像 SIM 那样严格控制照明模式、校准协议或聚焦光学器件，从而大大简化了实验装置。

Opto-Electronic Advances, 2023, **6**(7): 220163.
https://www.oejournal.org/article/doi/10.29026/oea.2023.220163.

Speckle structured illumination endoscopy

DOI: 10.12086/oee.2024.241004.h02

In microscopy, a method that is capable of attaining wide field of view with high temporal resolution and low phototoxicity is called structured illumination microscopic (SIM). In endoscopic imaging, the exceptionally wide FOV and large DOF are critical due to the very nature of endoscopic imaging and the samples they image and explore. Hence, to explore the possibility of achieving super resolution in endoscopic images at wide FOV and large DOF is of great interest.

The research group of Prof. Zhaowei Liu from the University of California San Diego propose and demonstrate a novel method called speckle structured illumination endoscopy utilized for achieving super resolution in images acquired during the process of endoscopy. introduce two fibers in a standard white light endoscope (WLE) to deliver high resolution speckles to illuminate the object. The wide FOV and the large DOF is obtained in this study along with super resolution by fashioning the optical light sources, namely, the multimode fibers carrying the random illumination patterns from the laser in an orientation to not only cover a wide FOV and DOF but also give rise to large angle interference between the illumination beams which contributes to achieving super resolution in imaging. The significance of this work mainly lies in enhancing image resolution at optimal imaging parameters of a wide field of view and large depth of field, as wide and large as a typical white light endoscope may allow in comparison to the existing high-resolution endoscopic state of the art which have very limited field of view and depth of field in its image examination and acquisition. Additionally, the system in this study does not rely on any specific properties of the specimen or sample, therefore, any sample can be used for imaging further broadening its potential impact and influence.

Opto-Electronic Advances, 2023, **6**(7): 220163.
https://www.oejournal.org/article/doi/10.29026/oea.2023.220163.