

Recognition of surface plasmon scattering based on deep learning

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Abstract

We investigate the method to recognize surface plasmon scattering image using deep learning approach. Surface plasmon scattering, which is one of the label-free imaging techniques, measures interference pattern of reflected field from metal surface and scattered field from target object. There are many applications using surface plasmon scattering, for example single nanoparticle detection, measurement of separation between cell and substrate, and measurement double strand DNA molecule, etc. Unlike fluorescence imaging, the image of surface plasmon scattering shows much worse resolution due to propagation length of surface plasmon polariton. Deep learning approach is taken to overcome this problem, and ultimately to detect target object in complex and noisy environment by multiple targets positioned in small area. Surface plasmon scattering image was generated by employing simple model: scattered intensity consists of interference of reflected field and scattered field. It is assumed that there are nanoparticles, which is called scatterer in this research, positioned within 3 μ m-square area, and the number of scatterers ranges 1 to 10. Noise is added to consider situations for different SNR of image, varied from 30 to 1 dB. The convolutional neural network was used as deep learning architecture for recognition of the number of scatterers in image. Conventional detection method based on fourier filtering and deconvolution is employed to compare the performance of the proposed method using deep learning. It was shown that deep learning improves the accuracy by about six times, and especially more useful in noisy environment. Also, recognition of target object in polydisperse could be possible, which could not be done by conventional method. These results suggest that surface plasmon scattering image can be analyzed more accurate and efficiently, while expecting that generalization for more scatterers in larger field-of-view.

Keywords: *surface plasmon resonance imaging, deep learning, scattering*

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Biography

Gwiyeong Moon received the Bachelor of Science (BS) in electrical engineering and electronic engineering from Yonsei University, Seoul, South Korea, in 2016. His research interests cover the development of system and algorithm for microscopy imaging. He works on imaging and sensing system with metal nanostructure to improve resolution and sensitivity. Also, He develops process and applies deep learning to analyze microscopy image more effectively.