

# Computational imaging by post-processing of speckles

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Imaging through randomness is a challenging problem due to the scrambling of the light. When a coherent beam travels through a random scattering media, it generates a coherent noise known as speckle. Several hardware-based techniques have been employed to cancel the randomness, including adaptive optics, transmission matrix, phase conjugation, etc. However, such hardware-dominated methods have strict practical constraints for optimal performance. On the other hand, an alternate route is to post-process the experimentally recorded speckle pattern.

In this talk, I will discuss the importance of post-processing speckle patterns in microscopy and our recent initiatives. With the strategy of exploiting randomness, we will discuss two methods for post-processing speckles. The first is to recover the complex Fourier spectrum from the second-order intensity correlation. The second is to use randomness for illumination and apply the auto-correlation for microscopy. These two techniques provide an alternative quantitative phase imaging and correlation microscopy approach.

Short biography:



Rakesh Kumar Singh is a Professor at the Department of Physics, IIT (BHU), India. Before joining the IIT (BHU), he was a faculty member at the IIST- Trivandrum. He obtained his master's degree from the BHU and Ph.D from the IIT Delhi. Dr. Singh was a JSPS fellow at the University of Electro-Communications (UEC), Tokyo, Japan, a postdoc researcher at the University of Oulu, Finland, and a visiting researcher at the National University of Ireland, Denmark Technical University, Kobe University, Tel Aviv University, Bar Ilan University Israel, and Huaqiao University China. He works in Optics and Photonics, including optical imaging, Biomedical optics, Optical Metrology, coherence optics, digital holography, laser speckle, etc. He is a senior member of the SPIE, Optica, and a life member of the Optical Society of India. Dr. Singh received the 2<sup>nd</sup> prize in the Dare 2 Dream 3 contest (individual category) by the DRDO-Govt of India in 2022 and the winner of the Fumio Okano Award 2024 by the SPIE. He has published more than 160 journals and conference papers and two Indian patents.