# IMAGING MOVING TARGETS THROUGH SCATTERING MEDIA

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Imaging in turbid media such as biological tissue is challenging primarily due to light scattering, which degrades resolution and limits the depths at which we can reliably image objects. There are two main approaches for realizing non-destructive optical imaging through scattering tissue: gated approaches, which serve to distinguish and reject the multiply scattered photons; and non-gated approaches, which detect both the unscattered and scattered light contributions, and leverage the information from the scattering process in order to image the object[1].

In terms of non-gated approaches, both wavefront shaping (WFS) and speckle-correlation-based imaging (SCI) techniques can achieve high-resolution imaging of objects hidden within scattering media[1,2]. WFS techniques exploit the principles of time-reversal to undo the effects of scattering, whereas SCI methods exploit the angular correlations inherent within the scattering process to reconstruct the hidden object. In contrast with WFS approaches, SCI methods do not need long acquisition times or the presence of a guide star[2]. However, SCI methods are currently limited to imaging sparsely tagged objects in a dark-field scenario, and are strongly impacted by noise from other sources.[2]

In this work, we establish a technique that allows SCI to image obscured objects in a bright-field scenario.[3] Our technique leverages the temporal correlations inherent in the scattering process to distinguish the object signal from the remaining, undesired 'background' light contributions. By using a deterministic phase modulator to generate a spatially incoherent light source, the background light contribution is kept constant between different acquisitions and can subsequently be subtracted out. As long as the object moves between acquisitions, the signal from the object can be isolated. The object can be reconstructed from this signal with high fidelity. Using this technique, we experimentally demonstrate successful reconstruction of moving objects hidden behind and between optically translucent materials. Due to the ability to effectively isolate the object signal, our work is not limited to imaging objects in the dark-field case, but also works in bright-field scenarios, with non-emitting objects. This ability opens up many potential applications for imaging in scattering media, such as through turbulent atmosphere or biological tissue, and makes this work relevant to the technical session on 'Biophotonics in scattering tissue.'

References

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