

Super-resolved imaging of obscured objects

E. Israeli, S. Elkabetz, A. Sanjeev, R. S. Rafeeka, G. Chen and Z. Zalevsky
Faculty of Engineering, Bar-Ilan University, Ramat-Gan 52900, Israel
e-mail: zeev.zalevsky@biu.ac.il

In this presentation we will present several schemes allowing us to perform high resolution imaging of obscured objects positioned behind scattering medium.

The first concept involves usage of time multiplexing super resolving technique that does not require a-priori knowledge on the projected encoding mask. The concept includes illuminating the object positioned behind scattering medium, through the scattering medium. This generates illumination of the object with speckle patterns. The patterns themselves are not a-priori known but the same projected pattern can be preserved and shifted by using the memory effect of the scattering medium. By properly capturing larger number of low-resolution images encoded with the projected time-shifting speckle patterns, a high-resolution image can be reconstructed after applying proper decoding algorithm.

Then, we discuss two schemes allowing 3D-position tunable focusing through and behind scattering medium. By scanning the object (that is positioned behind the scattering medium) with the position tunable focus one can perform its imaging. In the proposed schemes both the illumination module and the detection module are on the same side of the inspected object. In addition to that, the imaging process is a real time fast converging operation. The physics behind this concept involves either the assumption that the illuminating wavefront travels forward and backwards through the same scattering medium, or it uses temporal modulation (usage of pulsed light) of the spatial distribution of the illuminating beam to obtain the desired focusing.

All the presented techniques allow reference-free, non-invasive imaging through scattering medium and since our illumination system and the detection system are on the same side of the object, it does not require the direct access behind the medium nor using feedback from there. Thus, the presented concepts might be providing high added value utility for biological and medical non-invasive imaging based diagnostic tool.

Keywords: Scattering medium, speckle patterns projection, time multiplexing super-resolution.