High resolution deep tissue imaging of turbid media (Ramot)

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Technology

Imaging through turbid media such as occluding body fluids (e.g. blood, urine, CSF) is restricted due to strong scattering. In applications such as intravascular optical imaging applications clearing of the imaging path (the lumen) are done by, e.g., locally stopping blood flow.

The technology utilizes guided shaped light for minimally-invasive Angioscopy without the necessity to intervene with the natural flow of the fluid, thus reducing procedure risks, improving efficiency, and shortening procedure time.

Imaging contrast is achieved by relative reflection of scanned structured beams from the imaged surface.

The Need

Advancements in various optical and other physical modalities have opened new medical imaging possibilities such as OCT, Infrared spectroscopy, NIRS, IV-MRI, and Angioscopy imaging. These allow identifying vascular pathologies by inspecting their appearance, visual color and spectrum.

Angioscopy specifically can assist in detecting of hard cases, vulnerable plaques, and validation of stent placement. Still, it requires clearing the vessel lumen beforehand by inflating a balloon and injecting saline to increase visibility. It makes it more time consuming, increases the risks involved in the procedure, and incurs additional costs.

Clear view through turbid medium poses a special challenge. In some cases, where light-matter interaction is dominated by scattering (as opposed to absorption), there is a way to use special light beams that contain enough information to enable image reconstruction out of their reflected light.

Potential Application

High resolution, deep penetration imaging for Angioscopy applications:

• Imaging vulnerable plaques (VP)

• Stent placement validation

Stage of Development

The method was implemented in a lab prototype to demonstrate the ability to image a gold surface deposited on a glass slide through 1mm of milk water mixtures.

Patents

1. US Provisional Patent Application No. 62/371,781 filed on 07/08/2016
2. US Provisional Patent Application No. 62/444,436, filed on 10/01/2017

Supporting Publications

1. Accurate holographic imaging of colloidal particle pairs by Rayleigh-Sommerfeld reconstruction, David Kapfenberger, Adar Sonn-Segev, and Yael Roichman, Optics Express,21 , pp.12228-12237, (2013).
2. Independent and simultaneous three-dimensional optical trapping and imaging. Maya Yevnin, Dror Kasimov, Yael Gluckman, Yuval Ebenstein, and Yael Roichman, Biomedical Optics Express, 4, 2087-2094 (2013).
3. Tomographic phase microscopy with 180° rotation of live cells in suspension by holographic optical tweezers, Mor Habaza, Barak Gilboa, Yael Roichman, and Natan T. Shaked, Optics Letters, 40 1881-1884 (2015).
4. Non-diffracting beams for label-free imaging through turbid media. Harel Nagar, Elad Dekel, Dror Kasimov, and Yael Roichman. Submitted. .

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