2023 Departmental Poster Competition

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From 2D to 3D: Advancing Diagnostic Devices with Quantitative Phase Contrast

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Content :

Abstract

The review of the Digital Holographic Microscopy DHM approach, a type of quantitative phase imaging (QPI), for the 3D shape reconstruction of red blood cells (RBCs) and the computation of their dry mass and refractive index is the main objective of this study. This study, which focuses on novel developments in the field of medical diagnostics with a major interest in illness diagnosis and monitoring, aims to offer insightful information on RBC properties. The DHM approach for RBC analysis is being improved upon in this work. We rigorously adjust DHM setups, accounting for light sources, numerical aperture, and acquisition parameters, to obtain improved accuracy and resolution in recreating RBC forms. Through the incorporation of phase information and relevant biophysical parameters, we established a robust relationship that allows for the accurate enough determination of RBC dry mass, offering crucial insights into cellular health and potential disease conditions. The study also delves into the measurement of the refractive index of RBCs using DHM. A method for precisely determining the refractive index is tested by taking advantage of the natural phase shifts that cellular components introduce. This knowledge is crucial for comprehending changes in cellular structure and hydration in various pathological states. We show how DHM can efficiently distinguish RBC abnormalities in patients with hematological disorders based on volumetric parameters, demonstrating the clinical usefulness of our method. Our method enables accurate disease monitoring and early disease detection through a thorough analysis of RBC morphology and biophysical properties. As a result, the study offers a fresh and distinctive method for using DHM for RBC analysis in the context of medical diagnosis. We contribute to the understanding of RBC characteristics by refining and advancing existing QPI methodologies, which may offer benefits in disease diagnosis and patient care. Our unique contributions are expected to drive further advancements in medical imaging and diagnostic applications as the field of QPI evolves.

Primary authors : ABDILOV, Timur (Texas Tech University)

Co-authors : Prof. YAKOVLEV, Vladislav (Texas A University) ; CHEBURKANOV, Vsevolod (Texas A University)

Presenter : ABDILOV, Timur (Texas Tech University)

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