tegrated Mueller Matrix Near-infrared Imaging and Point-wise Spectroscopy for Cancer Detection

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Industry Problem

Colorectal cancer (CRC) is the third most commonly diagnosed cancer in males and the second in females worldwide, with an estimated 1.4 million cases and 693,900 deaths occurring in 2012. Current routine screening of CRC uses white light reflectance (WLR) colonoscopy which heavily relies on the visualization of gross mucosal features associated with neoplastic transformation. However, Subtle tissue changes may not be apparent under WLR colonoscopy, limiting its diagnostic accuracy. Overall, the current approach for colonic tissue diagnosis is clinically labor intensive and a burden to the patients.

Solution

NUS researchers developed and implemented a unique integrated Mueller Matrix NIR imaging and point-wise Mueller Matrix spectroscopy system for colonic tissue diagnosis and characterization. Point-wise Mueller Matrix diffuse reflectance (DR) spectra were acquired from suspicious areas as indicated by Mueller Matrix images. Polar decomposition algorithms were employed on the acquired Mueller Matrix images to derive three polarization metrics including depolarization, diattentuation and retardance. Partial least squares discriminant analysis (PLS-DA) and leave-one tissue site-out, cross validation (LOSCV) were implemented on the derived spectroscopic polarization metrics to develop robust spectral diagnostic models for the differentiation between cancerous and normal colonic tissues. The combination of the three polarization metrics with majority voting provides an enhanced colonic cancer detection with an accuracy of 95.0% (sensitivity of 93.3%, and specificity of 96.7%).

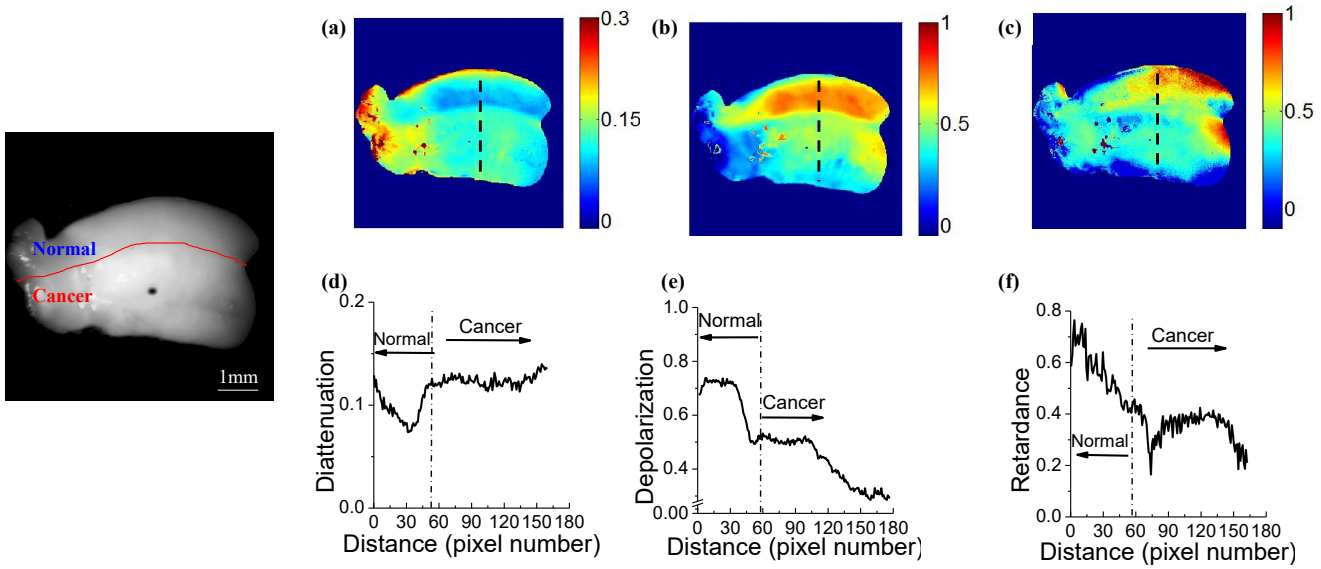

Fig. 1: *The processed colon tissues (a) diattentuation image, (b) depolarization image, and (c) retardance image. Intensity profiles (d-f) along the black dotted lines as indicated on the NIR Mueller Matrix images in (a-c)*

Value Proposition

- Improve early detection and diagnosis of malignant lesions
- Simplify diagnosis and reduce labor cost
- Objective diagnosis to decrease subjective examination which relies on experiences of pathologists

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