2018-700 DEEP LEARNING-BASED VIRTUAL HISTOLOGY STAINING USING AUTO-FLUORESCENCE OF LABEL-FREE TISSUE

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Technology description

BACKGROUND

One of the most widely used methods for diagnosing diseases in clinical pathologyis histological analysis of tissue samples. Preparing a tissue sample for imaging under a microscope is a lengthy and laborious process. Moreover, these steps use multiple reagents and introduce irreversible effects on the tissue. There have been recent efforts to reduce the laborious process using different imaging modalities, including non-linear microscopy. However, these methods use ultra-fast lasers or super-continuum sources, which might not be readily available in most settings and require longer scanning times due to weaker optical signals. Other microscopy methods which use the auto-fluorescence emission of biological tissue have also emerged.

INNOVATION

UCLA researchers have developed a deep learning-based virtual histology staining technique using auto-fluorescence of unstained tissue imaged with a wide-field fluorescence microscope. The virtual staining is performed by using a deep Convolutional Neural Network (CNN), which replaces the histochemical staining and bright-field imaging steps with the output of the trained neural net. The network inference is fast, taking ~0.59 sec using a standard desktop computer for an imaging field-of-view using a 40× objective lens. Each staining procedure of the salivary gland and thyroid tissue section on average takes ~45 min and the estimated cost, including labor, is $2-5. Furthermore, the presented method bypasses all the laborious staining steps, and allows unlabeled tissue sections to be preserved for later analysis, such as molecular analysis for customized therapies. This deep learning-based virtual histology staining framework can be broadly applied to other excitation wavelengths or fluorescence filter sets, as well as to other microscopy modalities such as non-linear microscopy. This approach would also work with non-fixed, non-sectioned tissue samples, potentially making it applicable for use in surgery rooms or at the site of a biopsy for rapid diagnosis.

Application area

Histological analysis of tissue samples

Non-linear microscopy

Virtual tissue staining
Telepathology

Advantages

Cost-effective
Quick analysis
Bypasses laborious staining steps
Allows unlabeled tissue sections to be preserved for later analysis

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