Performing tissue discrimination for cancer diagnostics using X-ray diffraction imaging

Value Proposition

Cancer diagnosis is a multi-step process involving a variety of specialties. Radiologists use macroscopic imaging systems to determine where to look for potential cancer, while pathologists use microscopic imaging to confirm cancer at the cellular level. With technological improvements, radiologists are detecting more lesions. To accurately diagnose malignancies, pathologists are tasked with analyzing each of these multiple lesions. This increased diagnostic burden requires more time, money and personnel resources spend on pathology procedures. As a result, there is a shortage of pathologists, and pathology delays account for 41% of delays in cancer diagnoses. In addition, pathology procedures are reimbursed capped per case. This reimbursement model requires pathologists to assess only a small fraction of the total lesion. This induces subjectivity and can impact diagnostic accuracy. A technology that can reduce workload, eliminate subjectivity and increase throughput will greatly benefit cancer diagnosis.

Technology

Duke inventors have developed an imaging system which can scan full-volumetric sliced samples of surgically resected tissue in a short time and automatically indicate the likelihood and location of cancer on each slice without the use of exogenous contrast agents. This technology is intended to help pathologists preview samples with the likelihood and location of cancer. With this invention, pathologists will know where to image and thus improve efficiency in workflow. Inventors take advantage of the fact that different tissue types (i.e. cancer, adipose, fibroglandular) display unique X-ray diffraction (XRD) signatures. They developed a coded aperture XRD imaging system using a line of broadband X-rays, a coded aperture, and energy-sensitive detectors. When the X-ray beam goes through a tissue specimen, it undergoes coherent scatter and gets deflected. The scattered X-rays could be detected by the energy-sensitive detectors to extract scatter information. Inventors then implemented algorithms to automatically process data acquired, and the material composition of the imaged sample can be represented with color-coding depicting the likelihood of cancer. When validated with a phantom material consisting of five different materials, this novel XRD imaging system was capable of obtaining a depth-resolved, color-coded representation of the object accurately identifying locations of cancer. Inventors further tested this imaging system with small animal and tumor samples.

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Duke File (IDF)

T-005319

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Links

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This invention is able to distinguish the cellular composition of different biological samples accurately within a few minutes. A prototype scanner has been deployed for clinical testing with Duke Pathology.

Advantages

- This imaging system can eliminate subjectivity and increase throughput of histological analysis
- Promising proof-of-concept results with patient specimens
- Can distinguish cellular compositions accurately within a few minutes
- Improves pathology workflow efficiency and reduces costs for each case

Publications

- Optimization of a coded aperture coherent scatter spectral imaging system for medical imaging (SPIE, 2015)