Tissue Stiffness Quantification for Diagnosis and Mapping
Technology #17896

Applications

This technology automatically diagnoses skin cancer through tissue characterization. This invention has applications for dermatologists, non-specialists like physicians and nurse practitioners, and patients who are able to perform self-measurement.

Problems Addressed

Melanoma is a dangerous disease that affects millions of people every year. It is clear that the single most promising strategy to reduce the mortality rate of skin cancer is early detection. In most clinical settings, physicians analyze the tissue using nothing more than sight. This method is only effective when performed by an experienced dermatologist. Because of these limitations, the gold standard for diagnosis has been invasive biopsy and excision, followed by histological and pathological examination. Studies have found that the ratio of biopsies of benign lesions to malignant ones can be as high as 500 to one, while at the same time one-third of skin cancers are missed. Visual diagnosis is thus commonly associated with a risk of missed melanomas (false-negatives) and unnecessary biopsies (false-positives). Current practices have insufficient specificity and sensitivity, and a better approach is required.

Technology

This invention relies on measuring skin stiffness, which is an intrinsic property that changes when tissue becomes cancerous. Stiffness measurements provide a quantifiable metric and a way to determine subcutaneous topology, and can be combined with standard automated image analysis of the lesion to diagnose and track the evolution of the lesion over time. This device automates the visual analysis and manual palpation that occurs when a patient visits the dermatologist, producing greater sensitivity and consistency while turning traditionally subjective tests into objective measurements. Using algorithms and digital imaging devices, this invention can measure tissue characteristics associated with cancerous lesions, such as asymmetry, border irregularity, color, diameter, elasticity and vasculature. To simulate manual palpation and estimate the stiffness of the lesion, an illuminated grid is superimposed on the skin and a constant force is applied to create a full-field normalized compliance map that can be used to quantify the stiffness of a cancerous lesion and the healthy tissue surrounding it. A difference in tissue stiffness indicates a higher probability that the lesion is cancerous. Once the tissue characteristics and stiffness are quantified, the data can be used with a machine learning algorithm to give a quantified score related to the probability that the lesion is cancerous. Furthermore, the same lesion can be monitored over time, as frequently as necessary, to evaluate the evolution of a lesion. If the lesion is considered to be cancerous, a normalized compliance map can be used to determine the boundary of the lesion which will provide a means to determine the extent of the lesion for excision. Boundaries can be projected on the lesion or the border can be directly printed or tattooed onto the tissue to provide the surgeon with a path to properly remove the lesion. This technology increases accuracy over traditional methods by removing complexity and subjectivity, thereby improving survival rates, reducing the number of unnecessary biopsies, and reducing overall costs to the healthcare system.
**Advantages**

- Maps the stiffness and morphology of a suspect lesion, otherwise traditionally observed through visual observation and palpation
- Provides a method to continually monitor the skin and provide alerts when changes are observed
- Improves skin cancer survival rates
- Enables real-time, in-situ identification of surgical margins

**Categories For This Invention:**

Medical Devices  
Diagnostic  
Therapeutic (Medical Devices)  
Life Sciences  
Clinical Applications  
Oncology  
Imaging

**Intellectual Property:**

Systems and methods for tissue stiffness measurements  
PCT  
2017-040680  
Systems and methods for tissue stiffness measurements  
US Patent Pending  
2017-0061621

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**Publications:**

LesionAir: a Low-cost Tool for Automated Skin Cancer Diagnosis and Mapping  
DSpace@MIT  
2016

**External Links:**

Precision Engineering Research Group  
http://pergatory.mit.edu/

**Image Gallery:**

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