

# Tactile Imaging Sensor for Subsurface Tumor Detection in Prostate Phantom

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## INTRODUCTION

IDENTIFYING and locating prostate tumors will greatly enhance the diagnosis and treatment of prostate cancer. For example, tumor identifying sensor may be used in individualized brachytherapy. This paper proposes a novel tactile imaging sensor to detect and locate the prostate tumor. To demonstrate the sensor, a realistic prostate phantom with hard inclusions is developed. The results showed that the tactile imaging sensor can detect and provide the relative depth information of the inclusions.

## MATERIALS AND METHODS

Fig. 1 shows a schematic diagram of the sensor module. The light sources have been adopted on all four sides of the optical waveguide. Total internal reflection principle does not allow the light to diffuse. However, when a waveguide is

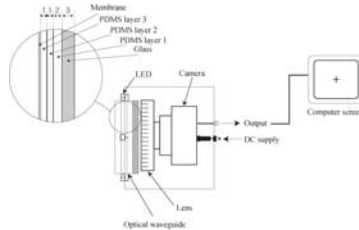


Fig. 1. Schematic of the tactile imaging sensor.

touched by an object, the contacted area of the waveguide deforms and causes the light to diffuse. The diffused light is captured by a digital imager.

For a prostate tumor detection experiment, a prostate phantom with embedded hard nodules has been developed. This phantom was made of a Zerdine composite having Young's modulus of 5~10 kPa. It was about three centimeters long and weighs about twenty grams [1]. Two hard spherical

inclusions were placed 2 mm and 4 mm below the upper surface of the phantom. The inclusions have Young's modulus of 100~300 kPa, much higher elasticity than the surrounding phantom material [2].

## RESULTS

The tactile images were obtained using tactile imaging sensor. We used the force around 1~2 N to compress the surface of the prostate phantom. No images were obtained if sensor touched the area without any inclusion. Fig. 2 shows the tactile images when there is a subsurface nodule.

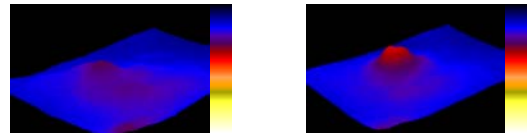


Fig. 2. 3-D tactile images. (a) Inclusion under 4 mm below the surface (left); (b) Inclusion under 2 mm below the surface (right).

To compare two tactile images, the horizontal tactile data through centroid is obtained and the Gaussian fitting model is used to describe the shape of tactile data. Fig. 3 shows the result. From the two curves, we determine the existence of the nodules, and the relative depth. The inclusion located 2mm from the surface is estimated as 2.3mm, and located at 4mm is estimated as 4.2mm.

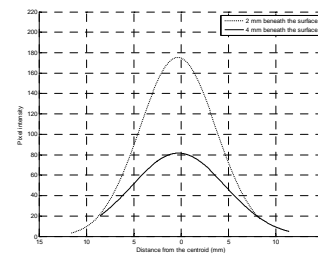


Fig. 3. Gaussian fitting model of tactile data

## REFERENCES

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