Abstract

Breast cancer is a disease in which malignant (cancer) cells form in the tissues of the breast. It often starts as a small lump in the breast, which can occur in both women and men. Worldwide, breast cancer is the fifth most common cause of cancer death (after lung cancer, stomach cancer, liver cancer, and colon cancer). Among women, breast cancer is the most common cancer and the most common cause of cancer death. Cervical cancer is another commonly occurring cancer amongst women. Both of these are eminently treatable provided detected at an early stage.

Amongst many approaches, the ones based on optical methods are emerging as potentially reliable tools for cancer detection. Optical spectroscopy in the ultraviolet to visible wavelength range can be used to measure tissue properties reflecting the intrinsic physiological and structural properties of tissue. Fluorescence spectroscopy is a reliable method because of its sensitivity. This technique has the potential to provide real-time, nondestructive and quantitative means for characterizing tissue pathology. Fluorescence techniques are being increasingly employed to investigate both morphological and biochemical changes in different tissue types, for eventual application in the detection of tumors at an early stage. Fluorescence spectroscopy is well suited for the diagnosis of cancerous tissues because of its sensitivity to minute variations in the amount and the local environment of the native fluorophores present in the tissues. Fluorescence emission can differ significantly in normal, benign and cancerous tissues due to the differences in concentration of absorbers and scatterers and also the scatterer sizes. The absorption in the visible range occurs

primarily due to the presence of blood, whose amounts vary in various tissue types. The presence of scatterers leads to randomization of light, thereby generating a depolarized component in the fluorescence spectra. Hence, polarized fluorescence spectroscopy is useful in isolating the characteristic spectral features from the diffuse background. A number of fluorophores e.g., NADH, flavins producing auto fluorescence have proved extremely useful for bioimaging.

The fact that the tissue is a complex medium, the intrinsic spectra is substantially modified by the medium before its detection. Both characteristic and statistical features of the spectra can reflect the nature and condition of the tissue. In this work analysis of tissue fluorescence will be done by the wavelet transform and singular value decomposition technique.

Wavelet transform is known as mathematical microscope which provides a multi-resolution analysis of the data under consideration. The data is separated into high frequency and low frequency components at multiple scales, known respectively as high pass and low pass coefficients. For example, high pass coefficients at level-1 represent variations at smallest scale and the subsequent higher level coefficients represent variations over bigger window sizes. The low pass coefficients at various levels represent average behavior of data over corresponding window sizes. The fact that cancerous tissues have irregular nuclei and scattering agents of different sizes, it is expected that randomization of fluorescence intensities will be more in cancerous tissues as compared to the normal ones. Keeping these aspects in mind, we employ wavelet transform to extract variations at various scales and also the average behavior, from the polarized fluorescence of normal, benign and cancerous tissues. These features are expected to be different in diseased and non-diseased tissues' fluorescence.

We will study the correlation properties of the fluorescence spectra by singular value decomposition also. We are expecting that the correlation matrix eigenvalues will confirm the nature of fluctuations, as

observed in the wavelet domain. It is also an independent method providing a dimensional reduction of the data which can be utilized for tissue differentiation and characterization. Polarized spectra will be analyzed here as in the case of wavelet transform.