VIETNAM NATIONAL UNIVERSITY-HCMC **SOCIALIST REPUBLIC OF VIETNAM**

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DISSERTATION INFORMATION

Research Title:	**Study on the application of polarized optical methods combined with diffuse reflectance spectroscopy in supporting cervical image analysis**
Major:	Engineering physics
Major Code:	9520401
PhD Candidate:	PHAN NGOC KHUONG CAT
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CONTENT:

In the field of cervical lesion diagnosis, accurate assessment of histological characteristics and microvascular structures plays a crucial role in early detection and effective treatment. Collagen, a primary structural protein in the extracellular matrix of connective tissue, ensures the mechanical strength and integrity of the cervix, while the microvascular network, composed mainly of red blood cells, provides essential oxygen and nutrients to maintain tissue function. Analyzing collagen fiber orientation and blood distribution in cervical tissue not only aids in the early detection of abnormalities but also provides a scientific basis for diagnosis and treatment. In this dissertation, three studies utilizing polarized light colposcopy combined with diffuse reflectance spectroscopy (PLC-DR) were conducted to analyze the biological and structural properties of cervical tissue. The first study focused on quantifying collagen fiber orientation using linear polarized imaging, leveraging the birefringence property of collagen to analyze the dispersion and alignment of these fibers in detail. The image processing selected the R channel of the RGB image, which is less affected by the light absorption of red blood cells, to optimize the analysis. The results revealed significant

differences in collagen fiber orientation between the Inner Zone (Zone 1) and Outer Zone (Zone 2) of the cervix, where fibers in Zone 2 were circumferentially arranged with lower dispersion, consistent with previous studies, emphasizing the role of collagen structure in maintaining cervical function. The second study applied cross-polarized imaging to enhance contrast between squamous epithelium (SE) and columnar epithelium (CE), reducing glare and improving visibility of deep tissue structures. By exploiting differences in epithelial layer thickness and light absorption at various wavelengths, a newly developed image processing algorithm significantly enhanced the contrast and sharpness of the SCJ boundary, effectively aiding early lesion detection. The final study aimed to quantify the distribution of red blood cells (RBC) in cervical tissue by constructing a two-layer model based on diffuse reflectance theory. A novel image processing algorithm produced visual color maps representing RBC concentrations, showing a strong linear correlation ($R^2 = 0.9473$) between diffuse reflectance signal intensity and RBC concentration, with higher RBC density observed in lesion areas compared to surrounding tissue. These studies demonstrated the potential of combining PLC-DR with image processing for non-invasive evaluation of cervical tissue properties, offering clinical applications to improve diagnosis, analyze collagen fiber orientation, and assess microcirculation, thereby contributing to enhanced women's healthcare.

Supervisors PhD. Candidate

Dr. Ly Anh Tu ***Assoc. Prof. Dr. Tran Thi Thu Hanh*** ***Phan Ngoc Khuong Cat***