INFORMATION ABOUT THE DISSERTATION

Ph.D. student:	**Tran Van Tien**
Title:	**Application of multispectral systems for the diagnosis in dermatology, endoscopy, and gynecology**
Major:	**Engineering Physics**
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ABSTRACT

The studies of light interaction and biological tissue today have shown good performance and created rich capabilities in determining information about the physiology, morphology, and composition of tissue. Because biological tissue is multilayered, multi-component, and optically heterogeneous, the interaction of light with tissue through the model of photon absorption and scattering corresponding to different spectrums of wavelengths has the specificity that fully describes the specific biophysical characteristics of the tissue. In the field of diagnostic imaging, the applications of light interaction with tissue have also achieved promising results in the investigation of tissue properties, towards the application and manufacture of modern, safe, and efficient medical diagnostic devices such as optical endoscopes used in otolaryngology and gynecology, dermatoscopy, vein finder, etc. The thesis focused on studying the application of light interaction with biological tissues, combined with digital image processing techniques to create specific methods and devices to support medical imaging in selected areas related to optical imaging of skin surfaces, middle ear and neck uterus. Based on experimental results combined with simulation, four imaging systems have been designed and tested to acquire images of different subjects including skin imaging system, limb veins, middle ear and cervical endoscopy. The light source used in the optical system is a high luminescence LED light source with different distinct spectral regions from visible to NIR light. The images of the acquired objects were processed and analyzed by image fusion algorithms built and developed based on the combination of multispectral images to enhance the ability to distinguish tissue from surrounding structures. Segmentation algorithms are used to detect and extract specific anatomical objects as well. The important results achieved by the thesis include: firstly, the effectiveness of the above proposed methods has been demonstrated by evaluating the contrast ratio of pathological morphologies in different tissues, in which the skin with a psoriasis lesion (high keratin), and human arm veins

(blood vessels - hemoglobin) were chosen to be fully investigated; secondly, the potential of using multi-wavelength imaging technique in the contrast enhancement of the tympanic membrane and malleus compared to the surrounding tissue in the human ear indicated that the red illuminated image not only fully enhanced the contrast of the object but also minimized the noise appearing in the image; and thirdly, a new algorithm for enhancing the blood contrast on the surface of the human cervical ectropion was proposed to produce a fused image of good contrast between the squamous epithelium and columnar epithelium regions on cervical ectropion. Mentioned optical techniques using suitable LED light sources, combined with properly developed digital image processing techniques, are opening up potential and promising applications in medical imaging, which meets the criteria of minimal invasiveness, safety, and flexibility to use.

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