

系級:

姓名:

學號:

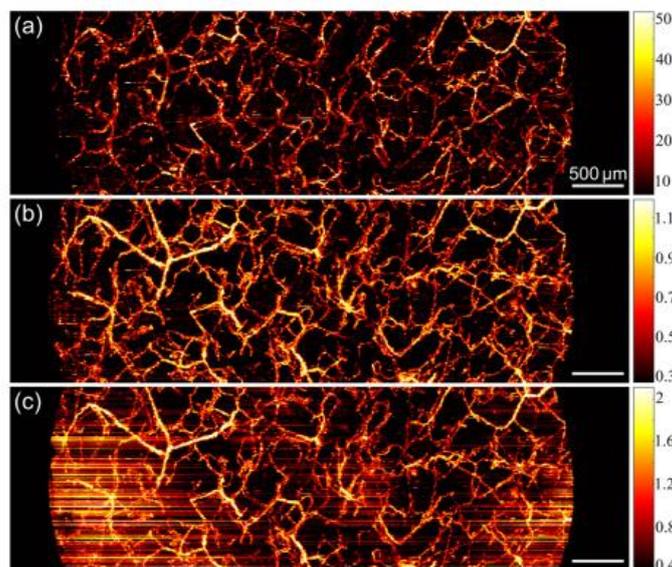
生醫光子學導論 期末考試題

2019/01/09

所有試題參考文獻請務必註明在「該題下方」，勿放在最後，並參照助教範例格式，若僅貼上網址會斟酌扣分。回答若能以圖表輔助表達為佳。撰寫答案時請使用中文(except you are native speaker of English)，回答問題時勿將參考文獻內容直接複製貼上，須自己理解整理後再行作答。考卷答案請於 2019/01/16 PM 01:20 前繳交。勿牽扯與題目無關之內容，檔名請以系級姓名命名並存成 PDF 避免格式錯誤。電子檔請上傳至學校 e3 平台並寄至: chiaweisun@nctu.edu.tw 以及 welly.eo06g@g2.nctu.edu.tw。

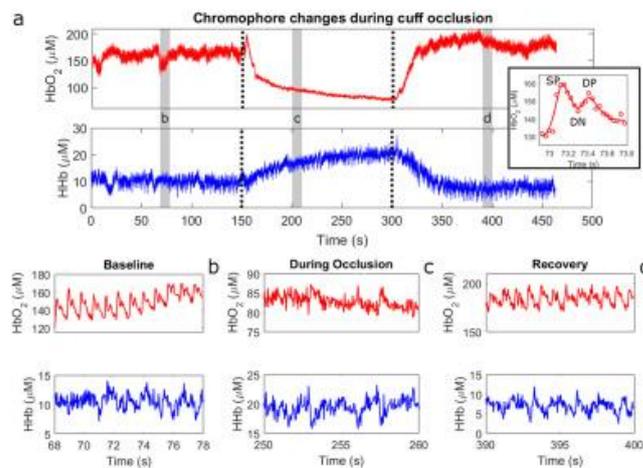
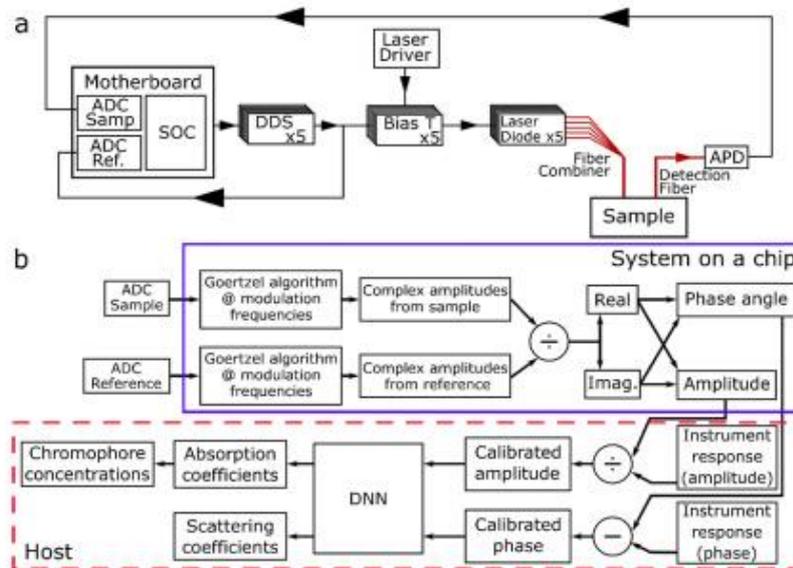
Please upload your answer to e3 platform AND send your answer sheet via email to chiaweisun@nctu.edu.tw and welly.eo06g@g2.nctu.edu.tw before 01/16/2019 PM 01:20.

1. Angiography has provided a valuable means to investigate and assess the vasculature in normal and diseased tissue. A research group presents a new optical coherence tomography (OCT) angiography method for imaging tissue microvasculature in vivo based on the characteristic frequency-domain flow signature in a short time series of a single voxel. Projection of blood vessels by short-time series OCTA based on OCT intensity signal is shown in the figure below.
 - (a) Please describe the setup of OCTA and its operation principle in detail. (10%)
 - (b) Discuss the meaning of experimental results below and it's novelty. (10%)



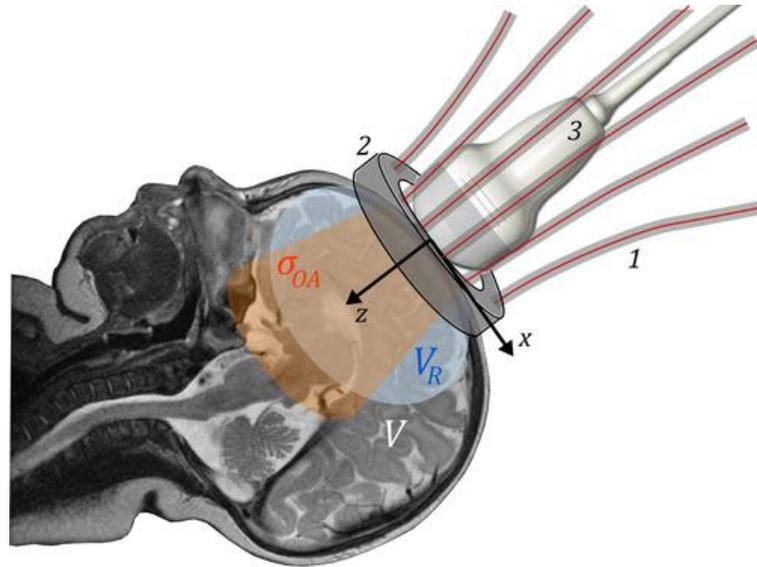
2. Pulse oximetry is a ubiquitous optical technology, widely used for diagnosis and treatment guidance. Current pulse oximeters provide indications of arterial oxygen saturation. A research group presents a new quantitative methodology that extends the capability of pulse oximetry and provides real-time molar concentrations of oxy- and deoxy-hemoglobin at rates of up to 27 Hz by using advanced digital hardware, real-time firmware processing, and ultra-fast optical property calculations with a deep neural network. The figures below show the system setup and the experimental results of hemoglobin detection.

- (a) Please describe the operation principle and how to apply the deep learning for optical parameters analysis. (10%)
- (b) The experimental results show the tissue oxyhemoglobin and deoxyhemoglobin traces from the thumb of a human subject. Please illustrate the physiological meaning and its applications in clinical diagnosis. (10%)



3. Choose your 2018 breakthrough technology of biophotonics of the year that may be a potential tool for medical instrument in clinical application and describe your reason in detail. (20%)

4. The schematic drawing of the combined optoacoustics (OA) and near-infrared optical tomography (NIROT) probe placed on an infant head, representing the volume V under investigation in the proposed clinical application.
- (a) Please illustrate the operation principles of OA and NIROT in detail, respectively. (10%)
- (b) How to combine the two modalities in one system? What are the benefits and it's values in clinical applications? (10%)



5. A high-speed polarization imaging instrument is demonstrated to be capable of measuring the collagen fiber alignment orientation and alignment strength during high-displacement rate dynamic loading in the figure below.
- (a) Please describe the optical principle of the polarization imaging system in detail. (10%)
- (b) The anisotropic property can be observed in highly aligned collagenous tissues. Please discuss the advantages of polarization monitoring of tissue birefringence and its clinical applications. (10%)

Schematic of the high-speed QPLM instrument using a polarized red laser.

