Special Bio-Photonics Seminar:

“From Optical Trapping to Single-Particle Spectroscopy & Optical Force Microscopy for Bio- and Nano- Applications”

Date: 11 November (Tuesday), 2003
Time: 10:30 a.m. – 12:00 noon
Location: HSH Engineering Building, Room 418
Speaker: Professor Arthur Chiou (Ph. D., Caltech; formerly Laser Science Research, Rockwell International and EE Professor, National Dong Hwa University, Hualien, Taiwan)

Dean, School of Medical Technology and Engineering
Professor, Institute of Biophotonics Engineering
National Yang-Ming University (formerly 陽明醫學院)
Pei-Tou, Taipei, Taiwan

ABSTRACT

Optical trapping and manipulation of micro-particles have been investigated for a wide variety of applications since the first experimental observation reported by Ashkin in 1970. This subject has received increasing attention in recent years due to their unique potential applications in biological, biomedical, and nano-sciences and technologies. An important biological application of optical trapping is the measurement of forces (on the order of pico-Newton) between biological objects such as DNA, RNA, protein, cell, and tissues. For such applications, optical forces have to be measured and calibrated. To date the most popular method for the measurement of the optical transverse gradient force on micro-particles is by dragging against the viscous force. In this approach a sample cell containing micro-particles (usually suspended in de-ionized water or in other transparent liquid) is dragged across the beam in a direction perpendicular to the beam axis when a particle is trapped in the beam. For a fixed dragging speed, the constant viscous force (given by the Stokes Law, $F_{vis} = 6\pi \eta rv$, where, $\eta$ is viscosity of the fluid, $r$ the radius of the particle, and $v$ the dragging speed) is balanced against the transverse optical gradient force. This approach is, however, quite time-consuming, and the result is subjected to a significant amount of unavoidable statistical fluctuation.

This talk will give a brief historical overview of optical trappings and discuss some of their potential applications including optical force transduction, optical patterning, single-particle spectroscopy, and optical force microscopy. Several novel approaches for the measurement of optical forces (on the order of tens of fN to tens of pN) and optical force constants (on the order of pN/µm) will be presented, and a few selected examples of bio- and nano-applications will be highlighted.

Contact: Prof. Chinlon Lin, CUHK, tel: 2609-8370, e-mail: chinlon@ie.cuhk.edu.hk