Cal Poly Pomona Mathematics and Statistics Department Colloquium

Monte Carlo method in biomedical optics

By

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Abstract: Biomedical optics is the study of propagation of light in human tissue for various non-invasive diagnostic and treatment purposes, e.g. an early detection of cancer.
Mathematical model of light propagation is given by the radiative transport equation (RTE).
Monte Carlo method (MC) of solving the RTE consists in replicating the fate of each individual photon literally millions of times in order to obtain statistical estimates of the distribution of light field. MC serves as a computational golden standard for otherwise intractable problems.
However, MC answers have statistical uncertainties that according to the central limit theorem decrease roughly on the order of W^(-1/2), where W is the number of samples. Increasing efficiency of MC is the area of constant research.
My talk is organized in the following way. First, the fundamentals of the MC method in general are explained. Examples include: using MC to evaluate integrals, inverse transform method of sampling random variables, reducing variance, simulating simple random walk process.
The rest of the talk is about the MC method applied to solve particle transport. RTE is introduced and a random walk process to simulate the solution to it is presented.
The talk concludes with the description of current research, in particular, how to take advantage of the forward-peaked nature of scattering in tissue in order to speed-up the MC simulations.

Thursday, November 16th, 2006, 12:05 – 12:50 p.m. in 8-156

Refreshments served at 12 noon.