Editorial

Mehdizadeh A.R.[1*]

[1]Deputy Editor in Chief, Department of Medical Physics, School of Medicine, Shiraz University of Medical Science, Shiraz, Iran

Monte Carlo simulations solve problems with deterministic nature using a stochastic analogy.

Old simulation methods, statistical sampling were used to estimate uncertainties in the results of simulation while simulate an understood deterministic problem. Monte Carlo methods, in all forms and applications start to solve a problem with defining a domain of possible inputs. Random input generating from a probability distribution over the predefined domain. Deterministic computation will be done on random generated inputs, and finally results would be aggregated to have a general solution for the problem. This is a computational, experimental method for problems with many independent variables, looking on stochastic nature of the universe.

In 18th century, one of the first Monte Carlo simulations was done by De Buffon. In his needle experiment, π can be estimated by dropping needles on a plan with parallel and equidistant strips.

Enrico Fermi was the first nuclear physicist, studying neutron diffusion with the Monte Carlo method, but did not publish anything on it.

Physicists at Los Alamos Scientific Laboratory were investigating. Despite having most of the necessary data, such as the average distance a neutron would travel in a substance before it collided with an atomic nucleus, and how much energy the neutron was likely to give off following a collision,

In 1946, the Los Alamos physicists were unable to solve the problem of radiation shielding and the distance that neutrons would likely travel through various materials, using conventional, deterministic mathematical methods. Stanislaw Ulam had the idea of using random experiments.

> *"The first thoughts and attempts I made to practice the Monte Carlo Method were suggested by a question which occurred to me in 1946 as I was convalescing from an illness and playing solitaires. The question was what are the chances that a Canfield solitaire laid out with 52 cards will come out successfully? After spending a lot of time trying to estimate them by pure combinatorial calculations, I wondered whether a more practical method than "abstract thinking" might not be to lay it out say one hundred times and simply observe and count the number of successful plays. This was already possible to envisage with the beginning of the new era of fast computers, and I immediately*

*Corresponding author: Mehdizadeh A. R. Deputy Editor in Chief Room No. 702, Department of Medical Physics, School of Medicine, Shiraz University of Medical Science, Shiraz, Iran E-mail: mehdizade@sums.ac.ir

thought of problems of neutron diffusion and other questions of mathematical physics, and more generally how to change processes described by certain differential equations into an equivalent form interpretable as a succession of random operations. Later, I described the idea to John von Neumann, and we began to plan actual calculations." Stanislaw Ulam

A colleague of Ulam, suggested using the name Monte Carlo, which refers to the Monte Carlo Casino in Monaco where Ulam's uncle would borrow money from relatives to gamble.

One of the best explanations about Monte Carlo methods was present by Professor John Guttag:

"Although in a deterministic simulation, you should get the same result every time you run it, but in stochastic simulations, the answer will differ from run to run, because there's an element of randomness in it."

To show, that simulations are in good relation with their inputs, accurate empirical data would highly important.

In medical physics, Monte Carlo has become ubiquitous over the last 60 years. Number of papers in this field doubled every 5 years between 1960s to 2000, however in 21st century the numbers leveled off.

While recognizing the many other roles that Monte Carlo techniques have played in medical physics, papers present in this issue show the application of Monte Carlo methods in external beam radiation therapy, electron therapy, brachytherapy and also in medical imaging. The broad range of codes available is mentioned but there is special emphasis on the MCNP and EGS4/ EGSnrc code system.

According to editorial board decision in 2015, JBPE try to publish papers with similar subject in each issue. Thanks to have first online section in journal's website and having DOI for in press papers, publication date of accepted papers would be less than a month and special subject issue would not lead to delay in publication of papers.

I wish you enjoy this issue of JBPE with main subject of Monte Carlo methods.

Conflict of Interest

None