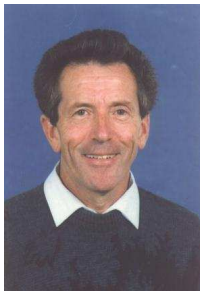
# Rubinstein wins the INFORMS Simulation Society Lifetime Professional Achievement Award



The Lifetime Professional Achievement Award is the highest honor given by INFORMS Simulation Society. The award recognizes major contributions to the field of simulation that are sustained over most of a professional career, with the critical consideration being the total impact of those contributions on the field. An individual's contributions may fall in one or more of the following areas:

- contributions to research,
- contributions to practice,
- dissemination of knowledge,
- development of software or hardware,
- service to the profession, and
- advancement of the status or visibility of the field.

The LPAA Selection Committee consists of Enver Yücesan (chair), Richard E. Nance, and Averill Law.

This year's winner of the LPAA is **Professor Reuven Rubinstein** of the William Davidson Faculty of Industrial Engineering and Management at Technion. Professor Rubinstein has received his PhD in Operations Research at Rigas Polytechnical Institute in Latvia in 1969. He has joined Technion in 1973. Over the years, he has held many visiting positions in Europe, in North America, in South Africa, Japan and New Zealand. He has served as an editor in *Stochastic Models*, *Methodology and Computing in Applied Probability*, and *Annals of Operations Research*.

"Professor Rubinstein has been a pivotal figure in the theory and practice of simulation as we know it today. His career reflects a high level of creativity and contribution, with a willingness to explore new areas and an amazing ability to suggest surprising new avenues of research and to influence subsequent work."

## Research

Professor Rubinstein has made major and very creative contributions to stochastic simulation methodology, over a period of over forty years, on the following topics:

- random search methods;
- learning and adaptive optimization algorithms;
- random variate generation;
- stochastic optimization via simulation;

- sensitivity analysis and gradient estimation (primarily via the score function approach and its variants);
- stochastic approximation and the stochastic counterpart method;
- adaptive importance sampling and splitting for rare event simulation;
- cross-entropy method for discrete and continuous optimization.

In particular, he made significant contributions to the early development of sensitivity analysis, gradient estimation, and optimization via simulation. More recently, he invented and developed the cross-entropy method, used for both rare-event simulation and optimization.

"His papers and work have served to elucidate fundamental and far-reaching connections between simulation, optimization, counting problems, and rare-event analysis."

The score function method provides an efficient mechanism for computing gradients of expectations depending on a decision parameter that affects the underlying probability distribution of the associated model. Such gradients play an important role in simulation-based continuous optimization of discrete-event models and in producing confidence intervals for performance quantities that take into account statistical uncertainty in the underlying input distributions.

With the stochastic counterpart method, Rubinstein was an early popularizer of an approach that has become main stream in the years since, namely that in using simulation to optimize a system that one can replace the expectation surface to be optimized by a sample-based version of that surface (followed by numerical optimization of the sample-based surface)

The cross-entropy method has broadly influenced not only the simulation community but also the CS (computer science) algorithms community and the optimization community. In its original version, the cross-entropy method was developed as a means of computing rare-event probabilities.

## Dissemination of Knowledge

Rubinstein has authored or co-authored seven books and over 100 papers over the course of his career.

His first book, *Simulation and the Monte Carlo Method*, published in 1981, was an early favorite reference of many current researchers in our field, and has greatly influenced subsequent research, as evidenced by the more than 2500 citations for this one book and its second edition.

"This book was ahead of its time in many ways, with a substantial discussion of simulation-based optimization methods in an era that was well before this became a major research area within our discipline."

His second book, *Discrete-Event Systems: Sensitivity Analysis and Stochastic Optimization* (co-authored with Alex Shapiro), has become a standard reference for researchers and practitioners who are exploring the use of sample-average approximation.

A third book that has significantly influenced the field is the 2004 volume, *The Cross-Entropy Method: A Unified Approach to Combinatorial Optimization, Monte Carlo Simulation and Machine Learning* (co-authored with Dirk Kroese).

"It is unusual to write even one book that significantly impacts a field. But Professor Rubinstein has authored or co-authored three such books, thereby greatly influencing the evolution of the field though clear exposition and excellent choice of topic (by often writing the first major book on a topic, thereby leading many others to later follow Rubinstein into further exploration of the area)."

## Advancement of Status and Visibility of the Field

A crucial aspect of Reuven Rubinstein's role in the simulation community is that he has often acted as a catalyst, stimulating people to start research in various unexplored areas of simulation.

"Rubinstein's work has had significant impact on both the research directions in which simulation has moved over the last thirty years, as well as the directions in which a number of related disciplines have evolved. As a consequence, the simulation community's status, prestige, and visibility have been greatly enhanced, as researchers outside our field look to simulation-based methods to solve various hard problems in counting and optimization."