THE CROSS-ENTROPY METHOD IN OPTIMIZATION AND MONTE-CARLO SIMULATION

R. Y. Rubinstein
ierrr01@ie.technion.ac.il

Faculty of Industrial Engineering and Management, Technion, Haifa, Israel

The cross-entropy (CE) method is one of the most significant developments in the fields of Monte-Carlo simulation and combinatorial optimization in recent years. The former includes probabilities of rare event estimation in queuing models; counting problems, like calculating the total number of routs (trajectories) in a TSP, calculating the permanent and the number of trajectories in a self-avoiding walk; the latter includes approximating the optimal solution of combinatorial and multi-extremal problems, like of Markovian decision problems under uncertainty and machine learning type of problems. The CE method presents a simple generic adaptive procedure, where each iteration contains two phases: (a) generating a random data samples (trajectories, vectors, etc.) according to a specified probability distribution; and (b) updating the parameters of the distributions associated with the data generated by the random mechanism in order to produce a "better" sample at the next iteration.

We will also present a new CE paradigm, called the MinxEnt Cross-Entropy (MCE) method, point out its relation to CE and discuss how CE and MCE are related to Sequential Monte-Carlo, MCMC and Gibs Sampler. We will finally discuss the complexity of CE and MCE algorithms, their convergence, and present supportive numerical results for high dimensional complex models. More details can be found in our home page `www.cemethod.org`.