中央研究院統計科學研究所
學 術 演 講

講　題：Computing low probabilities by accelerated Monte Carlo methods based on geometric properties of black-box computer models

演講人：Prof. Nicolas Bousquet
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時　間：2019年2月13日（星期三）上午10:30-12:00

地　點：中央研究院統計科學研究所6005會議室(環境變遷研究大樓A棟)

※茶　會：上午 10：10 開始

Abstract

Computing the probability of undesirable, unobserved events is a common task in structural reliability engineering. When dealing with major risks occurring with low probability, the lack of observed failure data often requires to use so-called computer models reproducing the phenomenon of interest. The simulation of their uncertain inputs, being modeled as random variables, allows to compute statistical estimators of a probability or a quantile. Usually these complex objects can be described as time-consuming black boxes. Therefore, exploring the configurations of inputs leading to failure, in a non-intrusive way, requires to run the model over a design of numerical experiments. Classical (quasi) Monte Carlo designs cannot be practically used to explore configurations linked to low probabilities since they require too high computational budgets. Therefore, numerous sampling techniques has been proposed in the literature to diminish the computational cost while ensuring the precision of estimations. Most of them are based on choosing sequentially the elements of the design, by maximizing an expected gain in information at each step.

This talk will provide a view of the most recent results when some geometric constraints can be detected or assumed on the limit (failure) state surface, as

monotonicity or convexity. Deterministic (conservative) bounds on probabilities or quantiles can be produced and narrowed by successive runs, and they become almost sure bounds when the design is chosen stochastically, and a great attention is paid to the parallel production of consistent estimators. Furthermore, the consistent estimation of the failure state surface can be produced, at a known speed, by a combination of constrained Support Vector Machines (SVM).

Beyond presenting such recent theoretical results, the talk will exhibit the good results obtained on several toy examples and real case-studies belonging to structural reliability engineering, and other possible applications in the more general field of applied decision theory.

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