

MICHIGAN STATE UNIVERSITY
Department of Statistics and Probability

JAMES FRANCIS HANNAN LECTURE SERIES

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Emulation of computer models I: Introduction

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Abstract

We consider computer models of complex processes, such as computer models that predict how a volcanic pyroclastic flow will run down a mountain. Emulation of a computer model is the process of finding a statistical approximation to the computer model that is much faster to evaluate than the computer model itself (which can often take hours or days for a single evaluation). This is nothing but statistical nonparametric function estimation; the computer model can be viewed as a function that can be evaluated at a modest number of inputs x , with the goal then being to estimate the function at other points. Almost ubiquitous in emulation of computer models is use of a Gaussian process (GaSP), for reasons that will be discussed. But the types of Gaussian processes used in emulation and the methods of fitting them are quite different than is typical in nonparametric function estimation or spatial statistics, partly because of the specific nature of computer models but primarily because of the (typically very limited) function evaluations that are available. These issues are discussed and illustrated, with various examples. The resulting methodology is implemented in a new R package, RobustGaSP, which should be high on the list for anyone needing to do emulation of computer models (or nonparametric function estimation with limited data).

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