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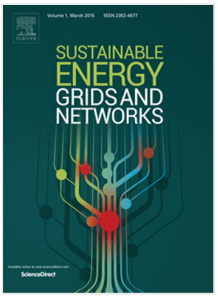

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Bayesian Framework for Power Network Planning Under Uncertainty

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Abstract

Effective transmission expansion planning is necessary to ensure a power system can satisfy all demand both reliably and economically. However, at the time reinforcement decisions are made many elements of the future system background are uncertain, such as demand level, type and location of installed generators, plant availability statistics, etc. Making decisions which account for such uncertainties is presently usually done by considering a small set of plausible scenarios, and the resulting limited coverage of parameter space limits confidence that the resulting decision will be a good one with respect to the real world. This paper presents a methodology which uses statistical emulators to quantify uncertainty in mathematical model outputs for all points at which it has not been evaluated, and hence to control properly uncertainties in the decision process arising from the finite size set of scenarios. The result is a generally applicable approach to network planning under uncertainty, including decision makers' risk preferences, which scales well with problem size. The approach is demonstrated on a Great Britain test problem, which replicates key features of the model the Transmission Owners use for practical strategic planning studies.

Keywords: power system planning, emulation, cost benefit analysis, uncertainty, risk

1. Introduction

Transmission system planning is key to ensuring that a system's future demand can be met both economically and with an appropriately low adequacy risk. Historically, systems were planned to maintain continuity of supply with any α components on outage, α commonly being 1; this is known as an N-α planning criterion [1, 2, 3, 4]. More recently, a number of authors (e.g. [1, 5, 6]) have suggested that the likelihood of events occurring must also be considered,

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