# New Monte Carlo method is computationally more effective for quantifying uncertainty

September 26 2017

Uncertainty quantification can be used in the positioning of new oil wells and determining how deep to drill for oil and gas. The information provides decision makers with a better understanding of the possible outcomes. Credit: Pixabay

Uncertainty quantification (UQ) is a statistical technique to predict many complex phenomena such as weather conditions and tsunami risks. It involves the combination of real-life data (e.g. weather measurements) together with mathematical equations to model physical systems that are well-understood. These complex models are usually associated with

either high-dimensional objects, large datasets or possibly both. In such scenarios, it is important that the required computational methodology to estimate such models is resource-efficient. Prof Ajay JASRA from the Department of Statistics and Applied Probability, NUS and his collaborators have proposed a more efficient approach to perform UQ calculations.

For UQ problems, the Monte Carlo method allows the user to numerically approximate quantities of interest in an efficient manner. Although there is an enhanced version, known as the Multilevel Monte Carlo (MLMC) method, it is challenging to use it for UQ problems. MLMC methods, for UQ problems associated to data is non-trivial to apply. This is because approximating the associated probability distribution, which is needed for the MLMC method to work is not always possible using independent simulation. In their recent paper, Prof Jasra and his collaborators have developed a new approach which allows MLMC to tackle UQ problems without compromising a high level accuracy while using less computational resources.

In future, the researchers plan to expand their statistical methods to tackle a greater range of problems. The statistical methods will also incorporate the multi-index Monte Carlo method which is a less computationally demanding method with similar accuracy to MLMC.

Prof Jasra said, "The ideas in this work can help to broaden the class of models used for uncertainty quantification problems, such as for weather prediction."

**More information:** Alexandros Beskos et al. Multilevel sequential Monte Carlo samplers, *Stochastic Processes and their Applications* (2016). DOI: 10.1016/j.spa.2016.08.004