Proposal Review 7 : 2152988

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Agency Name:	National Science Foundation
Agency Tracking Number:	**2152988**
Organization:	
NSF Program:	CDS&E-MSS
PI/PD:	Hickernell, Fred
Application Title:	Collaborative Research: Quasi-Monte Carlo for Efficient Simulation
Rating:	Good

Review

Summary

In the context of the five review elements, please
evaluate the strengths and weaknesses of the proposal with respect to intellectual merit.

Overview of Project:
The project will develop theoretical, methodological, and algorithmic advancements in Quasi-Monte Carlo (QMC) sampling methods. Broader impacts will be achieved through continued development of QMCPy, an open-source software library for QMC research, and indeed much of the project is organized around the software.

Intellectual Merits (IM):
The proposers are the originators of QMCPy, a python package for QMC research and applications. The package already seems quite sophisticated and has garnered the interest of a large number of people who are listed as collaborators.

Strengths of IM:
1) The history of the project is quite interesting in a way that one doesn't often enjoy in NSF proposals. 2) The proposers clearly have deep expertise in QMC research and application. 3) The software development is building on something that already exists, and so it is its own proof-of-concept. 4) The theoretical questions to be addressed are important ones, both in general and for use of the software.

Weaknesses of IM:
1) The proposers have such deep expertise in QMC that it is difficult to appreciate all the mathematical detail, such as the theorems. Many things are unexplained or assumed to be understood. What are scrambled nets? What is net cubature? What are Walsh coefficients? Maybe these things are well-known in the QMC community, but referencing them without any explanation renders large parts of the proposal very difficult to understand for anyone not as specialized as the proposers. 2) There are a number statements related to applications but none provide sufficient detail to evaluate whether the proposed research is likely to make a difference in those application areas.

In the context of the five review elements, please
evaluate the strengths and weaknesses of the proposal with respect to broader impacts.

Broader Impacts (BI):
The broader impact of the proposed advances is that the software and computation it enables, will stimulate further new research in theory and methodology. In addition these advances would presumably make QMC methods easier to deploy and exploit in applied problems.

Strengths of BI:
1) Section 4.2 makes a strong case for why this research is important. Uncertainty quantification, machine learning, and Bayesian methods are all critical for modern data analysis and the societal problems it can address. 2) QMCPy software as a vehicle stimulate new theory and methodology in response to new types of applied problems, is a compelling argument.

Weaknesses of BI:
1) Impact in the foreseeable future is limited to a pretty small slice of the math/stat/computing research community.

Please evaluate the strengths and
weaknesses of the proposal with respect to any additional solicitation-specific review criteria, if
applicable

The proposed work seems to fit with the objectives of the program.

Summary Statement

Fund if possible. The proposed work is technically solid, but in a very narrow area only. The broader impacts are weak.