Next Generation Uncertainty Quantification and Stochastic Media Monte Carlo Transport Methods

SAND2021-0912PE

Develop efficient uncertainty quantification (UQ) and stochastic media (SM) Mixed Monte Carlo Sampling (MMCS) transport methods for the GPU

Four MMCS goals:

- Develop UQ Methods
- Develop data-driven SM capabilities
- Adapt UQ tools to incorporate SM uncertainty
- Efficiently embed methods on the GPU

Wish List:

- Develop PCE term selection/regression approaches
- Quantify Sobol performance, new and traditional
- Expand MMCS PCE/Sobol prototyping
- Design MMCS UI/co-implementation strategies
- Your ideas!

LDRD Key Questions:

- What is possible?
- What is practical?

Internship Job Posting:

- Sandia Careers: https://bit.ly/2XzEuGD
- Posting number: 674437
- Posting live until February 22, 2021

Lead-up to Current Project (<Fall 2019):

- A.J. Olson, B.C. Franke. "An optimal-cost Monte Carlo approach to transport in stochastic media." *Trans. Am. Nucl. Soc.* Philadelphia, Pennsylvania, USA (2018)
- A.J. Olson. "Calculation of parametric variance using variance deconvolution." *Trans. Am. Nucl. Soc.* Minneapolis, Minnesota, USA (2019)
- E.H. Vu, A.J. Olson. "Conditional Point Sampling: A novel Monte Carlo method for radiation transport in stochastic media." *Trans. Am. Nucl. Soc.* Minneapolis, Minnesota, USA (2019)
- A.J. Olson, E.H. Vu, "An extension of Conditional Point Sampling to multi-dimensional transport." Proc. Int. Conf. on Math. And Comp. Meth. Apl. To Nuc. Sci. and Eng. Portland, Oregon, USA (2019)
- E.H. Vu, A.J. Olson. "An extension of Conditional Point Sampling to quantify uncertainty due to material mixing randomness." *Proc. Int. Conf. on Math. And Comp. Meth. Apl. To Nuc. Sci. and Eng.* Portland, Oregon, USA (2019)

Current Project (Fall 2019-Fall 2022):

- G. Geraci, A.J. Olson. "Efficient construction of polynomial chaos surrogate models using a Monte Carlo transport solver." *Proc. Int. Conf. on Math. And Comp. Meth. Apl. To Nuc. Sci. and Eng.* Raleigh, North Carolina, USA (2021, accepted)
- J. Petticrew, A.J. Olson. "Computation of Sobol' indices using Embedded Variance Deconvolution." *Proc. Int. Conf. on Math. And Comp. Meth. Apl. To Nuc. Sci. and Eng.* Raleigh, North Carolina, USA (2021, accepted)
- W. L. Davis IV, A.J. Olson, G. Popoola, D. Bolintineanu, T. Rodgers, E.H. Vu. "Using deep neural networks to predict material types in Conditional Point Sampling applied to Markovian mixture models." *Proc. Int. Conf. on Math. And Comp. Meth. Apl. To Nuc. Sci. and Eng.* Raleigh, North Carolina, USA (2021, accepted)
- A.J. Olson, S.D. Pautz, D. Bolintineanu, E. H. Vu. "Theory and generation methods for N-ary stochastic mixtures with Markovian mixing statistics." *Proc. Int. Conf. on Math. And Comp. Meth. Apl. To Nuc. Sci. and Eng.* Raleigh, North Carolina, USA (2021, accepted)
- L. Kersting, A.J. Olson, K. Bossler. "Conditional Point Sampling implementation for the GPU." *Proc. Int. Conf. on Math. And Comp. Meth. Apl. To Nuc. Sci. and Eng.* Raleigh, North Carolina, USA (2021, accepted)
- E.H. Vu, A.J. Olson, "Recent memory versions of Conditional Point Sampling for transport in 1D stochastic media" *Trans. Am. Nucl. Soc.* Virtual Meeting (2020)
- E.H. Vu, A.J. Olson. "Amnesia radius versions of Conditional Point Sampling for radiation transport in 1D stochastic media." *Proc. Int. Conf. on Math. And Comp. Meth. Apl. To Nuc. Sci. and Eng.* Raleigh, North Carolina, USA (2021, accepted)
- R. Davis, R.P. Kensek, C.M. Perfetti, A.J. Olson. "Revisiting the Lockwood albedo measurements for validation of the Integrated Tier Series electron-photon transport code." *Proc. Int. Conf. on Math. And Comp. Meth. Apl. To Nuc. Sci. and Eng.* Raleigh, North Carolina, USA (2021, accepted)

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