

CMWR2016 Short Course, Tuesday, June 21, 2016, 6 – 8 pm

Python & Matlab Software for Surrogate Global Optimization Toolbox in Water Resources

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Surrogate optimization has become more widely used in recent years because it can significantly reduce the computation time for optimization of computationally expensive simulation models, including those used in water resources. The optimization is commonly used for management/design analysis based on nonconvex or multimodal simulation models and/or for parameter estimation for these simulation models. The surrogate enables the optimization usually to vastly outperform algorithms like genetic algorithms or derivative-based methods on problems with multiple local minima and with a limited number of function evaluations. The speaker's research group has produced two documented, open source optimization toolboxes (in Python or Matlab) that can be used for optimization of complex simulation models (in multiple languages including C++ or Fortran) with continuous and/or integer variables. The Python code on NSF Yellowstone computer had excellent efficiency up to 64 processors.

A keynote address by Prof. Shoemaker at CMWR (June 21, 1:20 PM) will provide some background on the algorithms and examples of their application in Water Resources. The toolbox allows many options, like the type of surrogate, choice of single or ensemble of surrogates, serial or parallel computation, and many options to select an expensive simulation point from surrogate.

This short course will help participants load and utilize the Surrogate Optimization toolbox on test problems provided or on participants' own simulation codes. (It is not necessary to attend the keynote to successfully participate in the short course.) Participants are encouraged to bring their laptops to the short course, and (if they have time) load the software and print out the documentation before joining the short course. Computing Assistants will be on hand to help participants implement the software or to help anyone having difficulty installing the Python or the optimization software. Questions about the short course can be sent to Prof. Shoemaker (cas12@cornell.edu) with "Short Course" in the subject line before the start of CMWR conference. There is no fee for this course, but first priority for seats will be for people who notify the organizers at cmwr2016@ecf.utoronto.ca that they plan to attend.

A number of algorithm papers have been incorporated into the optimization toolbox . A very abbreviated bibliography for algorithms and applications is:

A. Espinet et al., **Water Resources Research** 49(7), 4442-4464, 2013.

Mugunthan, P., et al., **Water Resources Research** Vol. 41, W10428. 2005;

Regis, R.G. & C.A. Shoemaker, **INFORMS Jn. of Computing** 21(3), 411-426, 2009

Mueller, J. & C.A. Shoemaker, **Journal of Global Optimization**, 60 (2) p. 123-144, 2014

Links: The **Python** software "pySOT" is at <https://github.com/dme65/pySOT> and documentation is at <https://github.com/dme65/pySOT/blob/master/docs/pySOT.pdf> with examples of how to use it at <https://github.com/dme65/pySOT/tree/master/pySOT/test>. (pySOT had over 12,000 downloads in first 6 months.)

Matlab software "Matsumoto" is on J. Mueller website <https://courses.cit.cornell.edu/jmueller>.

