Space-filling experimental design using lattices

Derek Bingham
Simon Fraser University, Canada

Computer simulators are widely used to describe and explore physical processes. Often, the simulator runs are costly and a good choice of experimental design is crucial. In this talk a method of space-filling experimental design that is based on a novel type of sampling lattice is proposed. A key feature of the lattices is that that contain rotated and scaled versions of themselves. A hierarchy of grids is completely described by a lattice basis, an integer (dilation) matrix, and a shift of origin. To produce experimental designs of any desired run-size in a bounded region of interest, we optimize shift and rotation of the initial lattice. A key feature of our construction is that further run-sizes that result from refining or coarsening the initial grid can be chosen to vary by any integer factor as low as 2. Thus, we can find a series of lattices that can be run in sequence and that when superimposed also form a lattice. The designs have particular space-filling properties that make them uniquely attractive for computer experiments.