Matthew Parno

Population based optimization of mixed-variable problems with applications in hydrology

235 Albany St
Apartment 3073
Cambridge
MA 02139
mparno@mit.edu

Many difficult engineering optimization problems involve both continuous and discrete variables. Additionally, some problems may have discrete variables that alter the dimension of the continuous problem. Formally, this work considers problems of the form

$$\begin{aligned} \min \quad & f(x,y,z) \\ & z \in F_z \\ & y \in F_y(z) \\ & x \in F_x(y,z) \end{aligned}$$

where $F_z \subseteq Z^{n_z}$, $F_y(z) \subseteq Z^{n_y(z)}$, and $F_x(y,z) \subseteq \Re^{n_x(z)}$. The variables in F_z and $F_y(z)$ do not need to be ordered and can be categorical. In general, the continuous problem $f(z,y,\cdot)$ will be nonsmooth and derivatives will not be available. Thus, current algorithms alternate local searches with derivative free optimization algorithms on the continuous variables with a local search of the discrete parameters However, the continuous problem can often be noisy with many local minima.

To this end, we review the existing framework and demonstrate that a population based algorithm can also be used as a more robust continuous optimization algorithm. Numerical results are given for several academic problems as well as a hydraulic capture problem from hydrology.