Statistica Sinica: Preprint
doi:10.5705/ss.202017.0138

Performance tuning of computer codes is an essential issue in computer experiments. By suitable choosing the values of the tuning parameters, we can optimize the codes in terms of timing, accuracy, robustness, or other performance objectives. As computer software and hardware are becoming more and more complicated, such a tuning process is not an easy task, and there are strong needs for developing efficient and automatic tuning methods. In this article, we consider software auto-tuning problems that involve qualitative and quantitative tuning parameters by solving the resulting optimization problems. Because the performance objective functions in the target optimization problems are usually not explicitly defined, we build up surrogates from the response data and attempt to mimic the true, yet unknown, performance response surfaces. The proposed surrogate-assisted tuning process is an iterative procedure. At each iteration, surrogates are updated and new experimental points are chosen based on the prediction uncertainties provided by the surrogate models until a satisfactory solution is obtained. We propose two surrogate construction methods that adopt two infill criteria for the tuning problems containing qualitative and quantitative parameters. The four variants of the proposed algorithm are used to optimize computational fluid dynamic simulation codes and artificial problems to illustrate the usefulness and strengths of the proposed algorithms.