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**TemperSAT: A new efficient fair-sampling random  $k$ -SAT solver**

CHAO FANG, ZHENG ZHU, HELMUT G. KATZGRABER, Department of Physics and Astronomy, Texas A&M University — The set membership problem is of great importance to many applications and, in particular, database searches for target groups. Recently, an approach to speed up set membership searches based on the NP-hard constraint-satisfaction problem (random  $k$ -SAT) has been developed [S. Weaver *et al.* JSAT 8, 129 (2014)]. However, the bottleneck of the approach lies in finding the solution to a large SAT formula efficiently and, in particular, a large number of independent solutions is needed to reduce the probability of false positives. Unfortunately, traditional random  $k$ -SAT solvers such as WalkSAT are biased when seeking solutions to the Boolean formulas. By porting parallel tempering Monte Carlo to the sampling of binary optimization problems, we introduce a new algorithm (TemperSAT) whose performance is comparable to current state-of-the-art SAT solvers for large  $k$  with the added benefit that theoretically it can find many independent solutions quickly. We illustrate our results by comparing to the currently fastest implementation of WalkSAT, WalkSAT $lm$ .

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