J Autom Reasoning (2013) 51:325–356
DOI 10.1007/s10817-012-9263-4

SMELS: Satisfiability Modulo Equality with Lazy Superposition

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Received: 5 December 2010 / Accepted: 3 October 2012 / Published online: 18 October 2012

Abstract We consider the problem of checking satisfiability of quantified formulae in First Order Logic with Equality. We propose a new procedure for combining SAT solvers with Superposition Theorem Provers to handle quantified formulae in an efficient and complete way. In our procedure, the input formula is converted into CNF as in traditional first order logic theorem provers. The ground clauses are given to the SAT solver, which runs a DPLL method to build partial models. The partial model is reduced, and then passed to a Superposition procedure, along with justifications of literals. The Superposition procedure then performs an inference rule, which we call Justified Superposition, between the ground literals and the nonground clauses, plus usual Superposition rules with the nonground clauses. Any resulting ground clauses are provided to the DPLL engine. We prove the completeness of our procedure, using a nontrivial modification of the Bachmair and Ganzinger's model generation technique. We have implemented a theorem prover based on this idea by reusing state-of-the-art SAT solver and Superposition Theorem Prover. Our theorem prover inherits the best of both worlds: a SAT solver to handle ground clauses efficiently, and a Superposition theorem prover which uses powerful orderings to handle the nonground clauses. Experimental results are promising, and hereby confirm the viability of our method.

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