



## Special Issue of Selected Extended Papers of IJCAR 2020

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This special issue of the *Journal of Automated Reasoning* is dedicated to selected papers presented at the 10th International Joint Conference on Automated Reasoning (IJCAR 2020), initially planned to be held in Paris, but—due to the COVID-19 pandemic—held by remote conferencing during July 1–4, 2020. IJCAR is the premier international joint conference on all topics in automated reasoning, including foundations, implementations, and applications, comprising several leading conferences and workshops. IJCAR 2020 united CADE, the Conference on Automated Deduction, FroCoS, the International Symposium on Frontiers of Combining Systems, ITP, the International Conference on Interactive Theorem Proving, and TABLEAUX, the International Conference on Automated Reasoning with Analytic Tableaux and Related Methods.

The papers selected for this special issue underwent a two-round reviewing process. In the first round, the IJCAR 2020 programme committee selected 46 regular papers, 11 system descriptions, and 5 short papers from a total of 150 submissions. We invited authors of top-rated papers in the proceedings—as evaluated by the reviewers—to submit revised and extended versions of their papers to this special issue. In the second round, the submitted extended papers were reviewed using the normal reviewing process for journals in accordance with Journal of Automated Reasoning requirements.

The five selected papers in this special issue cover a wide range of topics in automated theorem proving, including the application of satisfiability checking to solving an open question, investigations of decidability for word problems, combinations of decision procedures, and transfer of decidability and uniform interpolation under combinations of theories.

In *The Resolution of Keller’s Conjecture*, by Joshua Brakensiek, Marijn Heule, John Mackey, and David Narváez, the authors solve Keller’s conjecture, which dates back to 1930. Building upon existing results that allow one to transform a geometrical problem into a graph problem (checking the existence of a clique in certain graphs), the authors make use of SAT-based technology to prove that certain formulas, which express whether such cliques exist, are unsatisfiable. An important asset of the work is that unsatisfiability proofs have been checked by formally verified proof checkers and hence the results should be reliable.

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In *Deciding the Word Problem for Ground and Shallow Identities w.r.t. Extensional Symbols* by Franz Baader and Deepak Kapur, the authors extend rewrite-based decision procedures for congruence closure (i) by adding functions that are defined by shallow equalities, and (ii) by adding functions that satisfy extensionality axioms, and show that the decision problem remains in P for both extensions. Furthermore, they show that the decision problem becomes coNP-complete if the same function is both commutative and satisfies a variant of extensionality.

In *Polite Combination of Algebraic Datatypes*, by Ying Sheng, Yoni Zohar, Christophe Ringeissen, Jane Lange, Pascal Fontaine, and Clark Barrett, the authors study the property of (strong) politeness for a theory of algebraic datatypes defined in the SMT-LIB standard and supported by several mainstream SMT solvers. Politeness is a property of first-order theories that has been studied for developing combination methods for satisfiability of sets of formulae. It is proved that the theory of algebraic datatypes is “strongly polite” and, therefore, can be combined with other arbitrary disjoint theories using polite combination.

In *Using Model-Theory to Find Decidable and Tractable Description Logics with Concrete Domains* by Franz Baader and Jakub Rydval, model theoretical conditions and strong algebraic tools needed for ensuring decidability and tractability of description logics with concrete domains are identified. This allows the authors to design new concrete domains  $\mathcal{D}$  leading to computationally interesting versions of  $\mathcal{ALC}(\mathcal{D})$  and  $\mathcal{EL}[\mathcal{D}]$ . The paper contains numerous results making essential bridges between description logics and CSP.

The paper *Combination of Uniform Interpolants via Beth Definability* by Diego Calvanese, Silvio Ghilardi, Alessandro Gianola, Marco Montali, and Andrey Rivkin, investigates uniform quantifier-free interpolants (sometimes referred to as “covers” in the literature) and cover transfer to theory combinations in the disjoint signatures case, and proposes an algorithm for this, relying on the usage of the Beth definability property.

The papers “Politeness for The Theory of Algebraic Datatypes” by Ying Sheng, Yoni Zohar, Christophe Ringeissen, Jane Lange, Pascal Fontaine, and Clark Barrett, and “The Resolution of Keller’s Conjecture” by Joshua Brakensiek, Marijn Heule, John Mackey, and David Narváez, shared the IJCAR 2020 Best Paper award.

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PC Chairs of IJCAR 2020, Guest Editors of the Special Issue

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