

# Shaowei Cai

## Curriculum Vitae, June 2020

Emails: [caisw@ios.ac.cn](mailto:caisw@ios.ac.cn); shaoweicai.cs@gmail.com

Tel: (+86)18515285536

Homepage: <http://lcs.ios.ac.cn/~caisw/>

Address: Room 210, Building 5, Institute of Software, Chinese Academy of Sciences, Zhongguancun, Beijing.

## 1. Education & Work Experience

### 1.1 Education

- Ph.D., IIS, Griffith University, Jul. 2012 – Jul. 2014
- Ph.D., Computer Science, Peking University, Sep. 2008 - Jul. 2012  
Distinguished Doctoral Dissertation Award from Peking University
- Bachelor of Engineering, Computer Science, South China University of Technology, Jul. 2008  
Academic records rank: 1st among 108.

### 1.2 Work Experience

- Sep. 2017 – now: Professor, State Key Laboratory of Computer Science, Institute of Software, Chinese Academy of Sciences
- Jul. 2014 – Sep. 2017: Associate Professor, State Key Laboratory of Computer Science, Institute of Software, Chinese Academy of Sciences

## 2. Research

I have broad interest in artificial intelligence, particularly including automatic reasoning, heuristic search and combinatorial optimization. I have published more than 60 peer-reviewed papers, mostly at top-ranking conferences or journals in artificial intelligence, including 7 papers in Artificial Intelligence Journal and 4 papers in Journal of Artificial Intelligence Research (the two flagship journals in artificial intelligence) as well as 27 papers at IJCAI/AAAI conferences between 2010 to 2020. I have proposed novel methods with transformative impact on local search for the Boolean Satisfiability (SAT) problem. SAT is a core problem in automatic reasoning and SAT solvers have been widely used in hardware/software verification and automatic theorem proving. My work has been recognized at several important international competitions, including gold medals in SAT Competitions and wins 21 out of 44 categories in recent 7 MaxSAT Evaluations. I have proposed the Configuration Checking strategy, which effectively addresses the cycling issue of local search algorithms, and has been widely used in state of the art algorithms for combinatorial optimization problems. I have designed efficient algorithms based on reasoning and search techniques for solving large scale combinatorial optimization problems, and hold the record for several important problems, including Maximum Clique, Minimum Vertex Cover, Graph Coloring, Dominating Set and Set Cover. My algorithms and their implementations have been prominently used in important real-world applications, including the radio spectrum repacking at US Federal Communication Commission (FCC), message scheduling in Tencent electronic map, as well as virtual machine pre-provisioning service and incident identification service of Azure cloud platform at Microsoft.

### 3. Awards and Honors

#### 3.1 International Competition Awards

- **Gold Medal Award** in Main track SAT, SAT Competition 2020
- **Gold Medal Award** in Incremental track, SAT Competition 2020
- **Silver Medal Award** in Planning track, SAT Competition 2020
- **Gold Medal Award** in FLoC (Federated Logic Conference) Olympics 2018.
- **Gold Medal Award** in No-Limits track, SAT Competition 2018.
- **Excellence Award** in Global Logistics Optimization Challenge 2018.
- **Silver Medal Award** in Sparkle SAT Challenge 2018.
- **Bronze Medal Award** in Random track, SAT Competition 2017.
- **Silver Medal Award** in Random track, SAT Competition 2016.
- **Silver Medal Award** in Hard-combinatorial SAT track, SAT Competition 2014.
- **Best Solver Award** in Random SAT track, SAT Challenge 2012.
- In **MaxSAT Evaluation 2020** incomplete solvers track, our solver was ranked **1st** in 2 categories (out of 4).
- In **MaxSAT Evaluation 2018** incomplete solvers track, our solver was ranked **1st** in 2 categories (out of 4).
- In **MaxSAT Evaluation 2016** incomplete solvers track, our solvers were ranked **1st** in 3 categories (out of 9).
- In **MaxSAT Evaluation 2015** incomplete solvers track, our solvers were ranked **1st** in 5 categories (out of 9).
- In **MaxSAT Evaluation 2014** incomplete solvers track, our solvers were ranked **1st** in 5 categories (out of 9).
- In **MaxSAT Evaluation 2013** incomplete solvers track, our solver were ranked **1st** in 4 categories (out of 9).
- **First Prize** in both Medium Sized categories (2vs2 and 4vs4), 2007 RoboCup China Open

#### 3.2 Selected Honors

- Zhiyuan Scientist, Beijing Academy of Artificial Intelligence, 2020
- Ranked 2<sup>nd</sup> in Chinese Academy of Sciences in “Artificial Intelligence” subarea, CS ranking (Chinese Academy of Sciences is the top 4<sup>th</sup> institution over the world in the ranking) <http://csrankings.org/#/index?ai&world>
- Distinguished Young Scholar, Institute of Software, Chinese Academy of Sciences, 2018
- Distinguished Doctoral Dissertation Award, Peking University, 2012
- Top-10 Distinguished Academic Fellow Award, EECS of Peking University, 2011
- Academic Innovation Award, Peking university, 2011

### 4. Professional Services

- **Chair:** Branch of Information and Management, Youth Innovation Promotion Association of Chinese Academy of Sciences, since 2019

- **Program Chair:** the first international workshop of Heuristic Search in Industry, conjunction with the 29th IJCAI Conference on Artificial Intelligence (IJCAI 2020)
- **Program Chair:** Constraints and Satisfiability Track, The 11th International Conference on Knowledge Science, Engineering and Management (KSEM 2018)
- **Junior Associate Editor:** Frontiers of Computer Science, since Dec. 2014
- **Guest Editor:** Science China Information Sciences, Special Focus on Constraints and Optimization in Artificial Intelligence, 2020
- **(S)PC Member:** IJCAI 2016,2017,2018,2019,2020; AAAI 2015,2016,2017,2018,2020
- **Reviewer:** Mathematical Reviews, Artificial Intelligence, Journal of Artificial Intelligence Research, Artificial Intelligence Review, IEEE Transactions on Evolutionary Computation, Europe Journal of Operation Research, Journal of Heuristics, International Journal of Computer Mathematics, Optimization Letters, Discrete Optimization, etc.

## 5. Publications

- (1) **Shaowei Cai\***, Zhendong Lei: Old techniques in new ways: clause weighting, unit propagation and hybridization for maximum satisfiability, [Artificial Intelligence](#) (AIJ) 287: 103354 (2020)
- (2) **Shaowei Cai\***, Xindi Zhang: Pure MaxSAT and Its Applications to Combinatorial Optimization via Linear Local Search. CP 2020: 90-106
- (3) Zhendong Lei, **Shaowei Cai\***: NuDist: An Efficient Local Search Algorithm for Weighted Partial MaxSAT, [The Computer Journal](#) 63(9): 1321–1337 (2020)
- (4) Chuan Luo, Holger Hoos, **Shaowei Cai**: PbO-CCSAT: Boosting Local Search for Satisfiability using Programming by Optimisation, 16<sup>th</sup> International Conference on Parallel Problem Solving from Nature ([PPSN 2020](#)), Leiden, The Netherlands, September 5-9, 2020
- (5) **Shaowei Cai\***, Wenying Hou, Yiyuan Wang, Chuan Luo, Qingwei Lin: Two-goal Local Search and Inference Rules for Minimum Dominating Set, 29th International Joint Conference on Artificial Intelligence ([IJCAI 2020](#)), Kyoto, January 5-10, 2021
- (6) Zhendong Lei, **Shaowei Cai\***, Chuan Luo: Extended Conjunctive Normal Form and An Efficient Algorithm for Cardinality Constraints, 29th International Joint Conference on Artificial Intelligence ([IJCAI 2020](#)), Kyoto, January 5-10, 2021
- (7) Bohan Li, Xindi Zhang, **Shaowei Cai\***, Jinkun Lin, Yiyuan Wang, Christian Blum: NuCDS: An Efficient Local Search Algorithm for Minimum Connected Dominating Set, 29th International Joint Conference on Artificial Intelligence ([IJCAI 2020](#)), Kyoto, January 5-10, 2021
- (8) Wenjie Zhang, Zeyu Sun, Qihao Zhu, Ge Li, **Shaowei Cai**, Yingfei Xiong, Lu Zhang: NLocalSAT: Boosting Local Search with Solution Prediction, 29th International Joint Conference on Artificial Intelligence ([IJCAI 2020](#)), Kyoto, January 5-10, 2021
- (9) Zhendong Lei, **Shaowei Cai\***: Solving Set Cover and Dominating Set via Maximum Satisfiability, Thirty-Fourth AAAI Conference on Artificial Intelligence ([AAAI 2020](#)), New York, USA, February 7-12, 2020.
- (10) Yiyuan Wang, **Shaowei Cai\***, Shiwei Pan, Ximing Li, Minghao Yin\*: Reduction and Local Search for Weighted Graph Coloring Problem, Thirty-Fourth AAAI Conference on Artificial Intelligence ([AAAI 2020](#)), New York, USA, February 7-12, 2020.
- (11) Peilin Chen<sup>#</sup>, Hai Wan<sup>#</sup>, **Shaowei Cai**<sup>#\*</sup>, Jia Li, Haicheng Chen: Local Search with Dynamic-threshold Configuration Checking and Incremental Neighborhood Updating for Maximum k-plex Problem, Thirty-Fourth AAAI Conference on Artificial Intelligence ([AAAI 2020](#)), New York, USA, February 7-12, 2020.
- (12) Yiyuan Wang<sup>#</sup>, **Shaowei Cai**<sup>#\*</sup>, Jiejiang Chen, Minghao Yin: SCCWalk: An Efficient Local Search Algorithm and Its

- Improvements for Maximum Weight Clique Problem, [Artificial Intelligence](#) (AIJ), 280: 103230 (2020). [Co-first author](#)
- (13) Yingjie Fu, Zhendong Lei, **Shaowei Cai\***, Jinkun Lin, Haoran Wang: WCA: A weighting local search for constrained combinatorial test optimization, [Information & Software Technology](#) 122: 106288 (2020)
  - (14) Yi Chu, Boxiao Liu, **Shaowei Cai**, Chuan Luo, Haihang You: An efficient local search algorithm for solving maximum edge weight clique problem in large graphs, [Journal of Combinatorial Optimization](#) 39(4): 933-954 (2020)
  - (15) Yuren Zhou, Xiaoyu He, Yi Xiang, **Shaowei Cai**: A set of new multi- and many-objective test problems for continuous optimization and a comprehensive experimental evaluation, [Artificial Intelligence](#) (AIJ) 276: 105-129 (2019).
  - (16) **Shaowei Cai\***, Yuanjie Li, Wenying Hou, Haoran Wang: Towards faster local search for minimum weight vertex cover on massive graphs, [Information Sciences](#) 471 (2019) 64–79.
  - (17) Yi Chu, Chuan Luo, **Shaowei Cai**, Haihang You: Empirical investigation of stochastic local search for maximum satisfiability. [Frontiers of Computer Science](#) 13(1): 86-98 (2019)
  - (18) Chuan Luo, Holger H. Hoos, **Shaowei Cai**, Qingwei Lin, Hongyu Zhang, Dongmei Zhang: Local Search with Efficient Automatic Configuration for Minimum Vertex Cover, 28th International Joint Conference on Artificial Intelligence ([IJCAI 2019](#)), Macao, China, August 10-16, 2019.
  - (19) Jinkun Lin, **Shaowei Cai\***, Chuan Luo, Qingwei Lin, and Hongyu Zhang: Towards more efficient meta-heuristic algorithms for combinatorial test generation, 27th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering ([FSE 2019](#)), Tallinn, Estonia, August 26-30, 2019.
  - (20) Yongjian Li, Kaiqiang Duan, David N. Jansen, Jun Pang, Lijun Zhang, Yi Lv, **Shaowei Cai**: An Automatic Proving Approach to Parameterized Verification, [ACM Transactions on Computational Logic](#) (TOCL) 19(4): 27:1-27:25 (2018).
  - (21) Yiyuan Wang, **Shaowei Cai\***, Minghao Yin: New heuristic approaches for maximum balanced biclique problem, [Information Science](#) 432: 362-375(2018).
  - (22) Kenji Kanazawa, **Shaowei Cai**: FPGA Acceleration to Solve Maximum Clique Problems Encoded into Partial MaxSAT, 12th IEEE International Symposium on Embedded Multicore/Many-core Systems-on-Chip ([MCSoc 2018](#)), Hanoi, Vietnam, September 12-14, 2018
  - (23) **Shaowei Cai\***, Wenying Hou, Jinkun Lin, Yuanjie Li: Improving Local Search for Minimum Weight Vertex Cover by Dynamic Strategies, 27th International Joint Conference on Artificial Intelligence ([IJCAI 2018](#)), Stockholm, Sweden, July 13-19, 2018.
  - (24) Zhendong Lei, **Shaowei Cai\***: Solving (Weighted) Partial MaxSAT by Dynamic Local Search for SAT, 27th International Joint Conference on Artificial Intelligence ([IJCAI 2018](#)), Stockholm, Sweden, July 13-19, 2018.
  - (25) Yiyuan Wang, **Shaowei Cai\***, Jiejiang Chen, Minghao Yin\*: A Fast Local Search Algorithm for Minimum Weight Dominating Set Problem on Massive Graphs, 27th International Joint Conference on Artificial Intelligence ([IJCAI 2018](#)), Stockholm, Sweden, July 13-19, 2018.
  - (26) Ruizhi Li, **Shaowei Cai**, Shuli Hu, Minghao Yin, Jian Gao: NuMWVC: A Novel Local Search for Minimum Weighted Vertex Cover Problem, Thirty-Second AAAI Conference on Artificial Intelligence ([AAAI 2018](#)), Hilton New Orleans Riverside, New Orleans, Louisiana, USA, February 2–7, 2018
  - (27) Chuan Luo, **Shaowei Cai\***, Kaile Su, Wenxuan Huang: CCEHC: An efficient local search algorithm for weighted partial maximum satisfiability, [Artificial Intelligence](#) (AIJ) 243: 26-44 (2017)
  - (28) **Shaowei Cai\***, Jinkun Lin, Chuan Luo: Finding A Small Vertex Cover in Massive Sparse Graphs: Construct, Local Search, and Preprocess, [Journal of Artificial Intelligence Research](#) (JAIR) 59: 463-494 (2017).
  - (29) Yiyuan Wang, **Shaowei Cai**, Minghao Yin: Local Search for Minimum Weight Dominating Set with Two-Level Configuration Checking and Frequency Based Scoring Function, [Journal of Artificial Intelligence Research](#) (JAIR) 58: 267-295 (2017).
  - (30) Haochen Zhang, **Shaowei Cai**, Chuan Luo, Minghao Yin: An efficient local search algorithm for the winner

- determination problem. [Journal of Heuristics](#) 23(5): 367-396 (2017)
- (31) **Shaowei Cai\***, Chuan Luo, Haochen Zhang: From Decimation to Local Search and Back: A New Approach to MaxSAT, 26th International Joint Conference on Artificial Intelligence ([IJCAI 2017](#)), Melbourne, Australia, August 19-25, 2017.
- (32) Jinkun Lin, **Shaowei Cai\***, Chuan Luo, Kaile Su: A Reduction based Method for Coloring Very Large Graphs, 26th International Joint Conference on Artificial Intelligence ([IJCAI 2017](#)), Melbourne, Australia, August 19-25, 2017.
- (33) Chuan Luo, **Shaowei Cai\***, Kaile Su, Wenxuan Huang: CCEHC: An Efficient Local Search Algorithm for Weighted Partial Maximum Satisfiability, 26th International Joint Conference on Artificial Intelligence ([IJCAI 2017](#)), Melbourne, Australia, August 19-25, 2017.
- (34) Yiyuan Wang, **Shaowei Cai**, Minghao Yin: Local Search for Minimum Weight Dominating Set with Two-Level Configuration Checking and Frequency Based Scoring Function, 26th International Joint Conference on Artificial Intelligence ([IJCAI 2017](#)), Melbourne, Australia, August 19-25, 2017.
- (35) Faisal N. Abu-Khzam, **Shaowei Cai**, Judith Egan, Peter Shaw, Kai Wang: Turbo-Charging Dominating Set with an FPT Subroutine: Further Improvements and Experimental Analysis, 14th Annual Conference of Theory and Applications of Models of Computation ([TAMC 2017](#)), Bern, Switzerland, April 20-22, 2017
- (36) **Shaowei Cai\***, Chuan Luo, Jinkun Lin, Kaile Su: New local search methods for partial MaxSAT, [Artificial Intelligence \(AIJ\)](#) 240: 1-18 (2016).
- (37) **Shaowei Cai\***, Jinkun Lin: Fast Solving Maximum Weight Clique Problem in Massive Graphs, 25th International Joint Conference on Artificial Intelligence ([IJCAI 2016](#)), New York, USA, July 9-15, 2016.
- (38) Yiyuan Wang, **Shaowei Cai**, Minghao Yin: Two Efficient Local Search Algorithms for Maximum Weight Clique Problem, Thirtieth AAAI Conference on Artificial Intelligence ([AAAI 2016](#)), Phoenix, Arizona USA, February 12–17, 2016.
- (39) Yongjian Li, Kaiqiang Duan, Yi Lv, Jun Pang, **Shaowei Cai**: A novel approach to parameterized verification of cache coherence protocols, 34th IEEE International Conference on Computer Design ([ICCD 2016](#)), Phoenix, USA, October 3-5, 2016.
- (40) Shohei Sassa, Kenji Kanazawa, **Shaowei Cai**, Moritoshi Yasunaga: An FPGA Solver for Partial MaxSAT Problems Based on Stochastic Local Search. [SIGARCH Computer Architecture News](#) 44(4): 32-37 (2016)
- (41) Chuan Luo, **Shaowei Cai\***, Wei Wu, Zhong Jie, Kaile Su: CCLS: An Efficient Local Search Algorithm for Weighted Maximum Satisfiability, [IEEE Transactions on Computers \(ToC\)](#) 64(7): 1830-1843 (2015).
- (42) **Shaowei Cai\***, Chuan Luo, Kaile Su: Improving WalkSAT By Effective Tie-breaking and Efficient Implementation, [The Computer Journal](#) (2015) 58 (11): 2864-2875.
- (43) Chuan Luo, **Shaowei Cai**, Kaile Su, Wei Wu: Clause States Based Configuration Checking in Local Search for Satisfiability, [IEEE Transactions on Cybernetics](#), 45(5): 1014-1027 (2015).
- (44) Lijun Wu, Huijia Huang, Kaile Su, **Shaowei Cai**, Xiaosong Zhang: An I/O Efficient Model Checking Algorithm for Large-Scale Systems, [IEEE Transactions on VLSI systems](#), 23(5): 905-915 (2015).
- (45) Lijun Wu, Kaile Su, **Shaowei Cai**, Xiaosong Zhang, Chenyi Zhang, Shupeng Wang: An I/O Efficient Approach for Detecting All Accepting Cycles, [IEEE Transactions Software Engineering. \(TSE\)](#) 41(8): 730-744 (2015).
- (46) **Shaowei Cai**, Zhong Jie, Kaile Su: An effective variable selection heuristic in SLS for weighted Max-2-SAT. [Journal of Heuristics](#) 21(3): 433-456 (2015)
- (47) **Shaowei Cai**: Balance between Complexity and Quality: Local Search for Minimum Vertex Cover in Massive Graphs, 24th International Joint Conference on Artificial Intelligence ([IJCAI 2015](#)), Buenos Aires, Argentina, July 25-31, 2015.
- (48) **Shaowei Cai\***, Jinkun Lin, Kaile Su: Two Weighting Local Search for Minimum Vertex Cover, Twenty-Ninth AAAI Conference on Artificial Intelligence ([AAAI 2015](#)), Austin Texas, USA, January 25–30, 2015.
- (49) Jinkun Lin, Chuan Luo, **Shaowei Cai**, Kaile Su, Dan Hao, Lu Zhang: TCA: An Efficient Two-Mode Meta-Heuristic

- Algorithm for Combinatorial Test Generation, 30th IEEE/ACM International Conference on Automated Software Engineering (**ASE 2015**), Lincoln, Nebraska, USA, November 9–13, 2015.
- (50) **Shaowei Cai\***, Chuan Luo, Kaile Su: CCAr: A Configuration Checking Based Local Search Solver for Non-random Satisfiability, 18th International Conference on Theory and Applications of Satisfiability Testing (**SAT 2015**), Austin, Texas, USA, September 24-27, 2015.
- (51) **Shaowei Cai**, Chuan Luo, Kaile Su: Scoring Functions Based on Second Level Score for k-SAT with Long Clauses, Journal of Artificial Intelligence Research (**JAIR**) 51, pp.413-441 (2014).
- (52) **Shaowei Cai\***, Chuan Luo, John Thornton, Kaile Su: Tailoring Local Search for Partial MaxSAT, Twenty-Eighth AAAI Conference on Artificial Intelligence (**AAAI 2014**), Qu ébec Convention Center, Qu ébec City, Qu ébec, Canada, July 27–31, 2014.
- (53) Chuan Luo, **Shaowei Cai\***, Wei Wu, Kaile Su: Double Configuration Checking in Stochastic Local Search for Satisfiability, Twenty-Eighth AAAI Conference on Artificial Intelligence (**AAAI 2014**), Qu ébec Convention Center, Qu ébec City, Qu ébec, Canada, July 27–31, 2014.
- (54) **Shaowei Cai\***, Kaile Su: Local Search for Boolean Satisfiability with Configuration Checking and Subscore, **Artificial Intelligence** (AIJ) 204, pp.75-98 (2013).
- (55) **Shaowei Cai\***, Kaile Su: Comprehensive Score: Towards Efficient Local Search for SAT with Long Clauses, 23th International Joint Conference on Artificial Intelligence (**IJCAI 2013**), Beijing, China, August 3–9, 2013.
- (56) **Shaowei Cai\***, Kaile Su, Chuan Luo: Improving WalkSAT for Random k-Satisfiability Problem with  $k > 3$ , Twenty-Seventh AAAI Conference on Artificial Intelligence (**AAAI 13**), Bellevue, Washington, USA, July 14–18, 2013.
- (57) **Shaowei Cai**, Kaile Su, Chuan Luo, Abdul Sattar: NuMVC: An Efficient Local Search Algorithm for Minimum Vertex Cover, **Journal of Artificial Intelligence Research** (JAIR) 46, pp. 687-716 (2013).
- (58) Chuan Luo, **Shaowei Cai\***, Wei Wu, Kaile Su: Focused Random Walk with configuration Checking and Break Minimum for Satisfiability, 19th International Conference on Principles and Practice of Constraint Programming (**CP 2013**), Uppsala, Sweden, September 16-20, 2013.
- (59) **Shaowei Cai**, Kaile Su: Configuration Checking with Aspiration in Local Search for SAT, Twenty-Sixth Conference on Artificial Intelligence (**AAAI 2012**), Toronto, Ontario, Canada, July 22–26, 2012.
- (60) **Shaowei Cai**, Kaile Su, Abdul Sattar: Two New Local Search Strategies for Minimum Vertex Cover, Twenty-Sixth Conference on Artificial Intelligence (**AAAI 2012**), Toronto, Ontario, Canada, July 22–26, 2012.
- (61) Chuan Luo, Kaile Su\*, **Shaowei Cai**: Improving Local Search for Random 3-SAT Using Quantitative Configuration Checking, 20th European Conference on Artificial Intelligence (**ECAI 2012**), Montpellier, France, Aug 27-31, 2012.
- (62) **Shaowei Cai\***, Kaile Su, Abdul Sattar: Local search with edge weighting and configuration checking heuristics for minimum vertex cover, **Artificial Intelligence** (AIJ) 175(9-10), pp. 1672–1696 (2011).
- (63) **Shaowei Cai**, Kaile Su: Local Search with Configuration Checking for SAT, IEEE 23rd International Conference on Tools with Artificial Intelligence (**ICTAI 2011**), Boca Raton, FL, USA, November 7-9, 2011
- (64) **Shaowei Cai**, Kaile Su, Qingliang Chen: EWLS: A New Local Search for Minimum Vertex Cover, Twenty-Fourth AAAI Conference on Artificial Intelligence (**AAAI 2010**), Atlanta, Georgia, USA, July 11–15, 2010.