(Invited Paper) Overview of 2024 CAD Contest at ICCAD

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ABSTRACT

The "CAD Contest at ICCAD" is a challenging, multi-month, research and development competition, focusing on advanced, real-world problems in the field of electronic design automation (EDA). Since 2012, the contest has been publishing many sophisticated circuit design problems, from system-level design to physical design, together with industrial benchmarks and solution evaluators. Contestants can participate in one or more problems provided by EDA/IC industry. The winners will be awarded at an ICCAD special session dedicated to this contest. Every year, the contest attracts more than a hundred teams, fosters productive industry-academia collaborations, and leads to hundreds of publications in top-tier conferences and journals. The 2024 CAD Contest has 221 teams from all over the world, which generates the highest participation record. Moreover, the problems of this year cover state-of-the-art EDA research trends such as logic optimization, multibit flip-flop, and Machine Learning (ML) for EDA from well-known EDA/IC companies. We believe the contest keeps enhancing impact and boosting EDA researches.

KEYWORDS

CAD Contest, electronic design automation, computer-aided design, logic optimization, multibit flip-flop, ML for EDA

1 Introduction

With rapid technological advancement and stringent specification requirements of modern electronic systems, the complexity of IC design has grown dramatically over the past decades. Electronic Design Automation (EDA), or Computer-Aided Design (CAD), is not only a category of software tools for designing electronic systems but also plays an extremely important role in tackling various design challenges, reducing design cycles, and achieving the best trade-off among performance, power, area, reliability, and cost. In order to boost EDA research, the *CAD Contest at ICCAD* [1] offers a platform for industrial companies to share various design problems and design cases while it encourages researchers in academia to study state-of-the-art IC design challenges and advance problem-solving techniques. The contest is a multi-month, research and development international competition, focusing on solving advanced, real-world problems from the industry with both theoretical solutions and practical software.

The CAD Contest originated as a domestic contest in Taiwan in 1999. It had been a successful annual competition activity, sponsored by the Ministry of Education (MOE), Taiwan, for cultivating talented young professionals in the EDA field while contributing to the semiconductor industry. Since 2012, the CAD Contest has been presented at IEEE/ACM International Conference on Computer-Aided Design (ICCAD) [2] – [13], under joint sponsorships of ACM Special Interest Group on Design Automation (SIGDA) [14], IEEE Council on Electronic Design Automation [15], MOE of Taiwan [16], and other industrial companies, including Cadence Design Systems, Inc. [17] and Synopsys, Inc. [18], while the contest environment, including both hardware and software, is supported by Taiwan Semiconductor Research Institute (TSRI) [19]. The contest has already been publishing many sophisticated circuit design problems [20] – [52], from system-level design to physical design, together with industrial benchmarks and evaluators.

Contestants from all over the world can participate in one or more problems provided by the industry. The winners will be awarded at an ICCAD special session dedicated to this contest. Every year, the contest attracts more than a hundred teams, fostering productive industry-academia collaborations, and leading to hundreds of publications in top-tier conferences and journals. The contest keeps enhancing its impact and boosting EDA research.

2 Contest Problems

The ICCAD-2024 CAD contest features the following three critical problems provided by Cadence Design Systems, Inc., Synopsys, Inc., and Arizona State University & NVIDIA Research, respectively.

- **Problem A "Reinforcement Logic Optimization for a General Cost Function"** provides a reinforcement logic optimization problem that encourages contestants to develop a program that interacts with the estimator and learns to perform optimizations to minimize the cost. Contestants are expected to develop an intelligent methodology to explore the

solution space, rather than relying on a cost-function-based algorithm for optimization and legalization of the design [53].

- **Problem B "Power and Timing Optimization Using Multibit Flip-Flop"** simulates the multibit flip-flop banking and debanking decisions in some virtual designs as testcases so that contestants would need to take timing, power, and area objectives together to find the best possible optimization solutions for each testcase [54].
- **Problem C "Scalable Logic Gate Sizing Using ML Techniques and GPU Acceleration,"** gives a design space exploration problem with the challenges of gate sizing techniques and drives academic research in timing optimization. The goal for contestants is to develop a scalable sizer that solves a constrained optimization problem [55].

It is worth mentioning that the three problems align with the research trends in the EDA field nowadays, and we believe the three valuable problems can not only incubate novel ideas and techniques but also attract more talents to join EDA-related research.

3 Contest Schedule

The contest starts in February and ends in November. The contestants need to carefully read the problem descriptions as well as reference reading from February, register for the contest by the mid of May, and submit their works for alpha, beta, and final stages in June, July, and August, respectively. The final evaluation will take place after the final submission, and the winners will be awarded at an ICCAD special session dedicated to this contest. The detailed schedule is shown in Figure. 1.

Figure 1. The contest schedules.

4 Registration Statistics

The contest this year receives 221 registered teams from 8 countries/regions, including Taiwan, Mainland China, Hong Kong, the United States of America (USA), Korea, Sri Lanka, Japan and India. Moreover. Figure 2 shows the numbers of registered teams and Figure 3 presents the countries/regions where the contestants reside from 2012 to 2024.
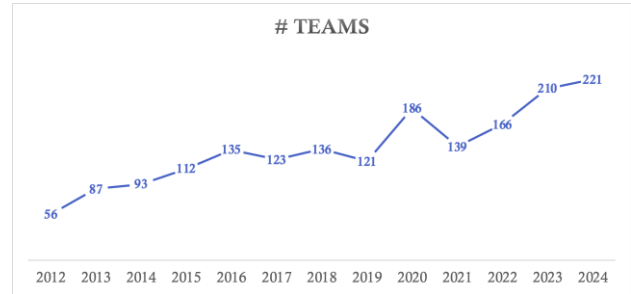

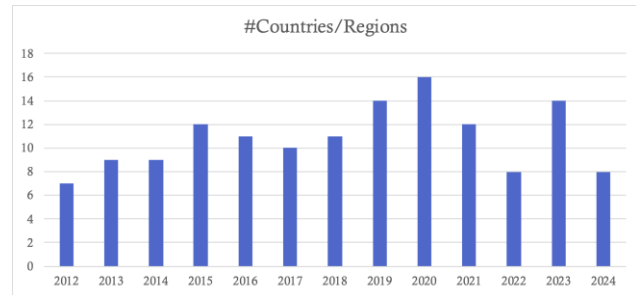Figure 2. The numbers of registered teams from 2012 to 2024.

Figure 3. The numbers of countries/regions where the contestants reside in from 2012 to 2024.

5 Award Ceremony

The award ceremony is held at an ICCAD-2024 special session. The session will give an overview of the 2024 CAD Contest, introduce the three contest problems to the community, announce the contest results, and present the awards to the winners. The video clips made by contestants, which introduce key ideas and algorithms to the contest problems, will also be played and demonstrated. The Design Automation Technical Committee (DATC) of IEEE CEDA will finally present the expanding research foundations for IC physical design and ML-enabled EDA.

6 Conclusions

The CAD contests at ICCAD have presented critical problems and industrial benchmarks to the academic community resulting in research breakthroughs and industry-academia collaborations since 2012. The contest has become one of the largest world-wide academic competitions, and attracted over 1400 international teams during 2012–2024. The published industrial benchmarks have been widely adopted by academia, resulting in numerous publications. The contest keeps enhancing its impact and boosting EDA research.

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