

The Ackermann Award 2025

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Abstract

Report on the 2025 Ackermann Award, on behalf of the EACSL Ackermann Award Jury.

2012 ACM Subject Classification Theory of computation → Logic and verification; Theory of computation → Finite Model Theory; Theory of computation → Proof theory; Theory of computation → Transducers

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Category Ackermann Award

Introduction

The Ackermann Award is the **EACSL Outstanding Dissertation Award for Logic in Computer Science**. It is presented at CSL, the annual conference of the EACSL (European Association for Computer Science Logic). This year the 21st Ackermann Award is presented at CSL 2026 in Paris, France. It is sponsored by *Amazon Automated Reasoning*.

A call for nominations was issued in April 2025, open to any PhD dissertation (on any topic represented at the annual CSL and LICS conferences) formally accepted by a degree-granting institution in fulfilment of the PhD degree between 1 January 2024 and 31 December 2024.

The Ackermann Award Jury received seven nominations. The nominated dissertations covered a wide range of areas in Logic and Computer Science and contained significant contributions to their particular fields. On behalf of the Ackermann Jury, we extend our warmest congratulations to all the nominated candidates for their outstanding work.

All the submissions were evaluated by the jury, and after two phases of reviewing and extensive discussion, the jury decided to grant the **2025 Ackermann Award** jointly to (in alphabetic order):

- **Toghrul Karimov** for the PhD thesis entitled *Algorithmic Verification of Linear Dynamical Systems*, completed at *Saarland University*, Germany, in 2024;
- **Nikolas Mählmann** for the PhD thesis entitled *Monadically Stable and Monadically Dependent Graph Classes: Characterizations and Algorithmic Meta-Theorems*, completed at *University of Bremen*, Germany, in 2024.



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Citation for Toghrul Karimov

Toghrul Karimov receives the *2025 Ackermann Award* of the European Association of Computer Science Logic for the PhD thesis

Algorithmic Verification of Linear Dynamical Systems,

which presents new decidability results for the fundamental class of linear dynamical systems. The main contributions are novel algorithms for the Model-Checking Problem, the Robust Safety Problem and the Pseudo-Orbit Reachability Problem, forging new connections between linear dynamical systems, symbolic dynamics and word combinatorics.

Background to the thesis

Linear dynamical systems are mathematical models widely used in engineering and science to describe systems that evolve over time. For example, they can be used to model simple while-loops in program analysis, or to model stochastic processes in probabilistic model checking. A discrete-time linear dynamical system is given by a matrix $M \in \mathbb{Q}^{d \times d}$ and a starting point $s \in \mathbb{Q}^d$. The trajectory of (M, s) (or orbit) is the sequence $(M^n s)_{n \in \mathbb{N}}$.

Despite their apparent simplicity, many reachability questions concerning linear dynamical systems have remained open for decades. The thesis addresses the Model-Checking Problem, which consists of deciding whether the trajectory of a given linear dynamical system satisfies a specification written as a monadic second-order formula. It generalises the reachability problem and can be alternatively defined using Büchi automata, as in this thesis.

Contributions of the thesis

One of the main contributions of the thesis is a novel framework in which decidability of various non-trivial classes of the Model-Checking Problem can be established. Previously, decidability was only known for restricted classes of specifications. The analysis of decidability results using the new approach advocated in the thesis shows that any significant generalisation would entail major mathematical breakthroughs in number theory. These results delineate a sharp boundary for the subclasses of the Model-Checking Problem for which decidability can be proven using contemporary mathematical tools. The thesis is remarkable for its use of deep ideas from algebraic number theory and Diophantine approximation.

In addition, the thesis explores the use of deep model-theoretic tools (in particular o-minimality in the theory of real exponentiation) to obtain decidability results for topological and robust variants of the reachability problem, relying on continuous abstractions of discrete orbits. In particular, the thesis shows that the reachability problem is decidable if we have access to an arbitrarily small control input at each step. This approach opens new directions to address verification problems for other fundamental classes of models, including continuous-time linear dynamical systems and simple forms of non-linear systems.

Biographical sketch

Toghrul Karimov carried out his PhD studies at Saarland University, under the supervision of Joël Ouaknine, from 2019 to 2024. During his PhD he (co)-authored 16 conference papers, including POPL 2021 and 2022, LICS 2023, 2024 and 2025, and ICALP 2025, and a journal article in Theoretical Computer Science. He obtained a Distinguished Paper Award at LICS 2024 and ACM SIGBED Best Paper Award at HSCC 2024. Currently he is a post-doctoral researcher at the Max Planck Institute for Software Systems, Saarbrücken.

Citation for Nikolas Mählmann

Nikolas Mählmann receives the *2025 Ackermann Award* of the European Association of Computer Science Logic for the PhD thesis

Monadically Stable and Monadically Dependent Graph Classes: Characterizations and Algorithmic Meta-Theorems,

which presents new tractability results for the Model-Checking Problem on graph structures, significantly extending the previously-known frontier of tractability.

Background to the thesis

The model checking problem in graph theory consists of deciding whether a given graph G satisfies a given first-order logic formula ϕ . A naive branching algorithm solves the problem in time $n^{O(|\phi|)}$, where n is the number of vertices of G and $|\phi|$ is the size of ϕ . Under standard complexity assumptions, a polynomial in n whose exponent depends on the size of ϕ is unavoidable. However, in practice the classes of interest have additional structure that can be exploited to obtain faster algorithms. The model checking problem is *fixed-parameter tractable* on a graph class C if it can be solved in time $f(|\phi|) \cdot n^c$ for some (arbitrarily fast-growing) function f and a constant c , on every n -vertex graph from C and formula ϕ . Well-known examples are the class of planar graphs and more generally the nowhere dense graph classes from sparsity theory. The thesis addresses the open question of characterising graph classes that admit fixed-parameter tractable model checking. It focuses on two important cases: the *monadically stable* and the *monadically dependent* graph classes. A graph class is monadically stable if it does not transduce the class of all half-graphs. For example, the nowhere dense classes are monadically stable, as well as all classes transducible from nowhere dense classes. Further generalising monadic stability, a class is monadically dependent if it does not transduce the class of all graphs.

Contributions of the thesis

The thesis makes major progress towards a resolution of the model checking conjecture, which predicts that for hereditary classes (i.e., classes closed under deletion of vertices) monadic dependence exactly delimits the tractability of the model checking problem. To analyse the tractability of the model checking problem, the thesis develops novel combinatorial characterisations for monadically stable and monadically dependent classes, which are more amenable to algorithmic treatment than the traditional definitions based on transductions. These combinatorial characterisations form an essential toolkit for the design of algorithms and are the foundation for one of the main results in the thesis: an algorithm that shows that the model checking problem is fixed-parameter tractable on every monadically stable graph class. They are also used to obtain another key contribution of the thesis: the hardness result for hereditary graph classes that are not monadically dependent.

Biographical sketch

Nikolas Mählmann carried out his PhD studies at the University of Bremen under the supervision of Sebastian Siebertz from 2021 to 2024. During this time he (co-)authored 10 articles, which were published in conference proceedings including LICS 2022, ICALP 2023 and 2025, STOC 2023 and 2024 and FOCS 2024. Currently he is a postdoctoral researcher at the University of Warsaw.

Jury

The jury for the **Ackermann Award 2025** consisted of twelve members, two of them *ex officio*, namely, the president and the vice-president of EACSL. In addition, the jury also included a representative of SIGLOG (the ACM Special Interest Group on Logic and Computation).

The members of the jury were:

- Albert Atserias (Technical University of Catalonia);
- Christel Baier (Technical University Dresden);
- Andrej Bauer (University of Ljubljana);
- Javier Esparza (Technical University of Munich);
- Maribel Fernández (King's College London), president of EACSL;
- Jean Goubault-Larrecq (ENS Paris-Saclay);
- Joost-Pieter Katoen (RWTH Aachen University), ACM SIGLOG representative;
- Delia Kesner (IRIF, University Paris Cité);
- Sławomir Lasota (University of Warsaw);
- Florin Manea (University of Göttingen), vice-president of EACSL;
- Prakash Panangaden (McGill University);
- James Worrell (University of Oxford).

Previous winners

Previous winners of the Ackermann Award were

2005, Oxford:

Mikołaj Bojańczyk from Poland,
Konstantin Korovin from Russia, and
Nathan Segerlind from the USA.

2006, Szeged:

Balder ten Cate from The Netherlands, and
Stefan Milius from Germany.

2007, Lausanne:

Dietmar Berwanger from Germany and Romania,
Stéphane Lengrand from France, and
Ting Zhang from the People's Republic of China.

2008, Bertinoro:

Krishnendu Chatterjee from India.

2009, Coimbra:

Jakob Nordström from Sweden.

2010, Brno:

no award given.

2011, Bergen:

Benjamin Rossman from USA.

2012, Fontainebleau:

Andrew Polonsky from Ukraine, and
Szymon Toruńczyk from Poland.

2013, Turin:

Matteo Mio from Italy.

2014, Vienna:

Michael Elberfeld from Germany.

2015, Berlin:

Hugo Férée from France, and
Mickael Randour from Belgium.

2016, Marseille:

Nicolai Kraus from Germany.

2017, Stockholm:

Amaury Pouly from France.

2018, Birmingham:

Amina Doumane from France.

2019, Barcelona (conference in 2020):

Antoine Mottet from France.

2020, Ljubljana (conference online in 2021)

Benjamin Kaminski from Germany.

2021, Göttingen (conference online in 2022)

Marie Fortin from France, and
Sandra Kiefer from Germany.

2022, Warsaw (conference in 2023)

Alexander Bentkamp from The Netherlands.

2023, Naples (conference in 2024)

Gabriele Vanoni from Italy.

2024, Amsterdam (conference in 2025)

Gaëtan Douéneau-Tabot from France, and
Aliaume Lopez from France.

Reports on their work appeared in the CSL proceedings and are also available on the EACSL homepage.