UNIVERSITATEA DE VEST DIN TIMIȘOARA

DOCTOR HONORIS CAUSA
SCIENTIARUM

Prof. Dr. Erika Ábrahám
RWTH Aachen University, Germany

17 septembrie 2024
Ora 15:30
Amfiteatrul A01
Universitatea de Vest din Timișoara

CUVÂNT
la deschiderea ceremoniei de acordare a titlului de
Doctor Honoris Causa Scientiarum
al Universității de Vest din Timișoara
Doamnei prof. univ. dr. Erika Ábrahám

Stimată doamnă profesor Erika Ábrahám,
Stimați membri ai comunității academice,
Stimați invitați,
Dragi studenți,
Onorat auditoriu,

Comunitatea academică a Universității de Vest din Timișoara este preocupată în mod constant de promovarea și recunoașterea meritelor științifice ale marilor personalități ale lumii științifice. Într-un an în care sărbătorim 80 de ani de la înființarea universității noastre prin decret regal, suntem onorați să recunoaștem meritele doamnei profesor Erika Ábrahám de la Universitatea RWTH Aachen, Germania.

Doamna profesor Erika Ábrahám s-a născut la Szeged, nu departe de Timișoara, a obținut o diplomă în informatică de la Universitatea din Kiel, Germania, și titlul de doctor de la Universitatea din Leiden, Olanda. În prezent este coordonatoarea grupului de cercetare în „Teoria sistemelor hibride” de la Universitatea din Aachen și desfășoară activități de cercetare în diverse domenii, cum ar fi verificarea satisfiabilității, sisteme hibride și probabiliste, sisteme de raționament automat cu aplicații în domeniul energiei verzi și al supercalculului. Cercetările sale combină fundamentele matematice cu ingineria riguroasă a sistemelor, generând noi teorii, algoritmi și instrumente pentru verificarea și certificarea sistemelor software.

De-a lungul timpului a obținut rezultate importante în mai multe domenii ale raționamentului automat și verificării formale. Una dintre direcțiile importante de cercetare pe care le-a inițiat împreună cu alți câțiva cercetători este combinația dintre calculul simbolic și verificarea satisfiabilității. Aceasta a dat naștere seriei de workshop-uri SC-square. Se poate spune că Universitatea de Vest din Timișoara a jucat un rol important în această inițiativă, deoarece primul workshop SC-square s-a desfășurat în cadrul seriei de conferințe SYNASC organizate anual, începând din 1999, de către Departamentul de Informatică. Numele profesoarei Erika Ábrahám este strâns legat de conferința SYNASC, ea fiind speaker invitat și apoi președinte al comitetului de program la edițiile anterioare ale conferinței.

Pe lângă aceasta, doamna profesor Erika Ábrahám a fost și este implicată în proiecte de parteneriat Erasmus+ coordonate de Universitatea de Vest din Timișoara, jucând un rol important în consolidarea cooperării dintre universitatea noastră și Universitatea din Aachen. În acest context a vizitat, în ultimii ani, de câteva ori Departamentul de Informatică din cadrul universității noastre, consolidând colaborările existente și stabilind altele noi.

Merită menționat faptul că este un promotor activ al tinerilor cercetători din domeniul informaticii, având abilități excelente de a motiva în special tinerele fete să își construiască o carieră în domeniul informaticii și fiind un adevărat model de urmat. Ca o recunoaștere a activității sale meritorii în această direcție, ea a primit premiul Brigitte-Gilles din partea Universității din Aachen, pentru implementarea unui program de îmbunătățire a echilibrului de gen în informatică. Ea nu este doar un cercetător strălucit și foarte energic, ci și o persoană deschisă și empatică, fiind foarte apreciată de foștii săi studenți și colaboratori.

Realizările sale sunt recunoscute de comunitatea științifică prin premii la concursuri și invitații de a susține conferințe la evenimente de prim rang din domeniile verificării formale și raționamentului automat.

Stimată Doamnă Profesor Erika Ábrahám,

Ne bucurăm că Universitatea de Vest din Timișoara are ocazia să vă răsplătească excelenta activitate științifică, oferindu-vă titlul de Doctor Honoris Causa.

Vă dorim multă sănătate și putere de muncă pentru a vă putea continua activitatea științifică cu aceeași neobosită energie și pasiune.

Prof. univ. dr. Marilen-Gabriel Pirtea

Rectorul Universității de Vest din Timișoara

Address
at the opening ceremony for awarding the title of
DOCTOR HONORIS CAUSA SCIENTIARUM
of the West University of Timișoara
to prof. univ. dr. Erika Ábrahám

Dear Professor Erika Ábrahám
Distinguished members of the academic community,
Dear guests,
Dear Students,
Ladies and Gentlemen,

The academic community of the West University of Timisoara is constantly concerned in promoting and recognizing the scientific merits of the great personalities of the scientific world. In a year when we celebrate 80 years since our university was established by royal decree, we are honored to recognize the achievements of Professor Erika Ábrahám from RWTH Aachen University, Germany.

Professor Erika Ábrahám was born in Szeged, not far away from Timișoara, obtained a degree in Computer Science from the University of Kiel, Germany and a doctoral degree from the University of Leiden, The Netherlands. Currently she is the head of the research group in "Theory of Hybrid Systems" from RWTH Aachen University and conducts research activities in various areas such as satisfiability checking, hybrid and probabilistic systems, deductive proof systems with applications on green energy and supercomputing. Her research combines mathematical foundations with rigorous systems engineering, yielding new theories, algorithms and tools for verifying and certifying software systems.

Over time, she has been influential in several areas of automated deduction and verification. One important research direction initiated with a few other researchers is the combination of symbolic computation and satisfiability checking. This gave rise to the SC-square series of workshops. West University of Timisoara also played a great role in this initiative, since the first SC-square workshop was organized in the framework of the SYNASC series of conferences that is organized yearly, since 1999, by the Department of Computer Science. The name of professor Erika Ábrahám is strongly related to the SYNASC conference, as she was invited speaker and then program chair at previous editions of the conference.

Besides this, Professor Erika Ábrahám was and is currently involved in Erasmus+ partnership projects coordinated by the West University of Timișoara, playing an important role in the consolidation of the cooperation between our university and RWTH Aachen University. In

this context she visited the Department of Computer Science from our university several times in the past few years, enhancing the existing collaborations and establishing new ones.

Professor Erika Ábrahám is an active promoter of young researchers in Computer Science, having excellent abilities to motivate particularly young girls to build a career in Computer Science and being a true role model. As a recognition of her meritorious work in this direction she received the Brigitte-Gilles award from RWTH Aachen University, for the development and execution of a program to improve gender balance in Computer Science. She is not only a brilliant and very energetic researcher but also an open and empathetic person, being highly appreciated by her former students and collaborators.

Her achievements are recognized by the scientific community through prizes at competitions and invitations as keynote speaker at top tier venues related to formal verification and automated reasoning.

Dear Professor Dr. Erika Ábrahám,

We are delighted that the West University of Timisoara has the opportunity to reward your excellent scientific activity, by offering you the title of Doctor Honoris Causa.

We wish you good health and work power so that you can continue your scientific activity with the same relentless energy and passion.

Prof. univ. dr. Marilen-Gabriel Pirtea

Rector of the West University of Timișoara

LAUDATIO
în onoarea
Prof. Dr. Erika Ábrahám
cu ocazia acordării titlului de
DOCTOR HONORIS CAUSA SCIENTIARUM
al Universității de Vest din Timișoara

Domnule Rector,

Domnule Președinte al Senatului Universității de Vest din Timișoara,

Stimați membri ai comunității academice,

Distinși oaspeți,

Verificarea satisfiabilității (SAT) formulelor logice de ordinul întâi este esențială într-o mare varietate de aplicații, cum ar fi, de exemplu, verificarea programelor și analiza terminării acestora, execuția simbolică, generarea cazurilor de testare, sinteza programelor și a controlerelor, optimizarea combinatorială, proiectarea produselor, planificarea și programarea, învățarea automată, pentru a menționa doar câteva. În prezent, solver-ele SAT pot rezolva cu succes probleme industriale uriașe cu milioane de variabile. Impulsionat de acest succes, domeniul de aplicare a fost extins la logici mai bogate și a apărut un nou domeniu de cercetare: Satisfiability Modulo Theory (SMT). În prezent, tehnicile de tip SMT sunt utilizate pe scară largă în numeroase aplicații, inclusiv verificarea, sinteza, planificarea sau automatizarea proiectării produselor.

Avem privilegiul de a onora astăzi realizările unui om de știință recunoscut la nivel mondial în domeniul metodelor formale, care a adus contribuții substanțiale la dezvoltarea și aplicarea soluțiilor SAT și SMT, precum și la cercetarea metodelor formale pentru sistemele probabilistice și hibride.

Distins auditoriu,

Erika Ábrahám și-a finalizat studiile de informatică cu diplomă de onoare la Christian-Albrechts-University din Kiel (Germania). A obținut doctoratul la Universitatea din Leiden (Țările de Jos) pentru lucrările sale privind dezvoltarea și aplicarea sistemelor de demonstrare prin deducție pentru programele concurente. În perioada postdoctorală s-a mutat la Universitatea Albert-Ludwigs din Freiburg (Germania), unde a început să lucreze la dezvoltarea și aplicarea soluțiilor SAT și SMT. Din 2008, este profesor la Universitatea RWTH Aachen (Germania), concentrându-și principalele activități de cercetare asupra tehnicilor SMT pentru aritmetica din

domeniul numerelor reale și a celor întregi, precum și asupra metodelor formale pentru sistemele probabiliste și hibride.

Interesele sale de cercetare acoperă un domeniu larg în cadrul metodelor formale, cei trei piloni principali fiind:

- rezolvarea automată a formulelor logice, cu accent pe teoriile aritmetice, utilizând tehnici de verificare a satisfiabilității,
- modelarea și analiza sistemelor hibride, al căror comportament acoperă atât dinamica continuă, cât și cea cu evenimente discrete, și
- algoritmi și instrumente pentru sinteza și verificarea sistemelor cu comportament incert, modelate folosind teoria probabilităților.

În domeniul raționamentului automat, Erika Ábrahám a adus contribuții majore legate de rezolvarea eficientă a ecuațiilor aritmetice. În acest context, Laura Kovacs, profesor la Universitatea Tehnică din Viena subliniază că:

„Munca ei transformă abordările de eliminare a cuantificatorilor în instrumente de raționament eficiente pentru rezolvarea satisfiabilității proprietăților aritmetice (neliniare). Extinderile sale recente privind rezolvarea problemelor aritmetice reale liniare, în special în abordarea FMpex, au remodelat peisajul raționamentului aritmetic. Eficiența muncii sale este demonstrată de solver-ul SMT-RAT, prin care a transferat „frumusețea matematică" în „euristici eficiente" pentru calculul simbolic în tehnicile de rezolvare SMT".

Pe de altă parte, în raportul său de apreciere, profesorul Dorel Lucanu de la Universitatea „Al. I. Cuza" din Iași a scris că:

„Erika Ábrahám are, de asemenea, contribuții semnificative în domeniul Satisfiability Modulo Theories (SMT), în special pe teme care includ aritmetica reală neliniară fără cuantificator, probleme SMT care implică teorii algebrice reale, planificare și programare bazate pe SMT. În rezumat, cercetările sale acoperă atât aspecte teoretice, cât și aplicații practice contribuind prin lucrările sale la avansarea stadiului actual al tehnologiei în toate domeniile menționate mai sus."

Contribuțiile sale influente și cu impact în domeniul sistemelor hibride permit analiza formală a modelelor autonome, cu aplicații la verificarea sistemelor cyber fizice. Munca sa surprinde dinamica sistemului prin ecuații diferențiale și codifică incertitudinea sistemului prin acțiuni probabiliste. Ea a fost pioniera cercetării în verificarea hiper-proprietăților probabilistice, deoarece aceste proprietăți sunt esențiale în asigurarea securității sistemelor stochastice. Realizările sale includ: Flow*, un analizor pentru sisteme hibride neliniare care combină analiza accesibilității cu tehnici de abstractizare, precum și modelul Taylor de construcție a căilor de flux, care oferă supra-aproximații ale seturilor accesibile pentru sistemele neliniare.

Doamna profesor Erika Ábrahám este foarte productivă și bine conectată la comunitatea științifică internațională. În cadrul colaborărilor naționale și internaționale, ea a realizat 16 proiecte și este coautoare a 200 de publicații cu 180 de coautori. Profilul ei scientometric poate fi, de asemenea, descris în cei mai elocvenți termeni, cu peste 4 800 de citări, un indice i10 de 91 și un indice h de 35, conform Google Scholar.

Ea este, de asemenea, un expert foarte căutat, cu un număr semnificativ de prezentări la conferințe de top, școli de vară sau discuții invitate la instituții academic. A susținut mai mult de 90 de conferințe invitate în cadrul unor evenimente de top privind metodele formale, precum ETAPS și CAV, și a fost coorganizator a 6 seminarii Dagstuhl. A fost membră în 8 comitete directoare și în peste 160 de comitete de program. A prezidat 21 de conferințe și ateliere, a făcut parte din patru comitete editoriale și a evaluat propuneri de proiecte pentru numeroase agenții naționale și internaționale, precum Comisia Europeană, DFG din Germania, FFG, FWF și FEMtech din Austria, NSERC din Canada sau FCT din Portugalia.

Erika Ábrahám este un mare motivator al științei și un inițiator al unor noi direcții de cercetare. În prezentarea intitulată „Building bridges between symbolic computation and satisfiability checking" susținută în cadrul conferinței ISSAC 2015, ea a subliniat izolarea comunităților de calcul simbolic și de verificare a satisfiabilității și a evidențiat potențialul care ar putea fi atins prin conectarea lor. Discursul său a inspirat inițierea proiectului *„SC2-Satisfiability Checking and Symbolic Computation - Uniting Two Communities to Solve Real Problems"*, care a condus la crearea unei comunități ce oferă o platformă pentru schimburi și colaborare. Aceasta a deschis multe noi domenii de cercetare în calculul simbolic și verificarea formală, transformând întâlnirile de lucru ale proiectului în prestigioase locuri de prezentare și de publicare a rezultatelor din calculul simbolic și verificarea formală. Unul dintre cele mai importante rezultate obținute de Erika Ábrahám în urma acestui efort comun este metoda de acoperire algebrică cilindrică pentru rezolvarea formulelor algebrice reale, care adaptează ideile metodei de descompunere algebrică cilindrică și oferă o soluție alternativă cu efort de calcul redus. Metoda de acoperire a fost implementată în solver-ul SMT cvc5, care a câștigat competiția SMT în 2022 în categoria problemelor algebrice reale fără cuantificator. A susținut prezentări excelente în cadrul unor evenimente de prim rang în domeniu, în special la CAV 2024, LPAR 2024, ETAPS 2021 și IJCAR 2018.

Pe lângă aspectele pur științifice, Erika Ábrahám a adus contribuții importante la consolidarea prezenței femeilor în domeniul informaticii, la nivel european, în cadrul grupului de lucru WIRE al Informatics Europe, ca reprezentantă a Germaniei în cadrul acțiunii COST Eugain, și la nivel local, ca responsabil adjunct pentru egalitatea de șanse la Universitatea RWTH Aachen. Ea a ținut numeroase discursuri încurajatoare în cadrul școlilor doctorale și a servit ca mentor în diferite programe. În plus, este un adevărat model pentru generația tânără. Eforturile sale de a îmbunătăți echilibrul de gen și diversitatea în informatică au fost recunoscute prin premiul Brigitte-Gilles. În raportul său de apreciere, Prof. dr. James Davenport o consideră pe Erika Ábrahám un

model extraordinar, care „contribuie foarte mult la acțiunile de încurajare a fetelor și femeilor de a-și construi o carieră în domeniul informaticii”.

Erika Ábrahám a participat la evenimente științifice organizate la Universitatea de Vest din Timișoara, în particular la conferința Symbolic and Numeric Algorithms for Scientific Computing (SYNASC). Inițial a fost speaker invitat la SYNASC 2016, după care a susținut un tutorial cu tema *SMT Solving for Arithmetic Theories* la SYNASC 2017, iar în 2019 a fost co-președinte de program. În plus, a stabilit colaborări puternice cu membri ai departamentului de Informatică din cadrul Universității de Vest din Timișoara, în cadrul a două proiecte de cercetare finanțate la nivel european: *„Automated Reasoning in the Classroom (ARC)”*, un proiect în cadrul programului european Erasmus+ ce are ca scop îmbunătățirea educației în domeniul raționamentului automat; și “*From zero to expert! Introducing the potential of AI and Robotics for all! (AiRobo)*” un proiect care își propune să crească nivelul de competență și abilitățile personalului academic relevant în domeniul roboticii bazate pe inteligența artificială.

Doamnelor și Domnilor,

Pe baza argumentelor academice și științifice și a dovezilor de expertiză profesională excepțională prezentate mai sus, Universitatea de Vest din Timișoara este onorată să acorde titlul de Doctor Honoris Causa Scientiarum doamnei profesor Erika Ábrahám de la Universitatea RWTH Aachen.

De asemenea, doresc să-mi exprim recunoștința față de Rectorul și Senatul Universității noastre pentru decizia de a o onora și să vă adresez, distinsă profesoară Erika Ábrahám, cele mai calde felicitări și vă urez o carieră lungă și de succes ca cercetător și profesor.

Membrii Comisiei de analiză pentru acordarea titlului onorific de *Doctor Honoris Causa Scientarium*

Președinte:

Prof. dr. Marilen Gabriel PIRTEA, Rector al Universității de Vest din Timișoara, România

Membri:

Prof. dr. James Davenport, University of Bath, United Kingdom
Prof. dr. Daniela Zaharie, Universitatea de Vest din Timișoara, România
Prof. dr. Laura Kovacs, Technical University of Vienna, Austria
Prof. dr. Mircea Marin, Universitatea de Vest din Timișoara, România
Prof. dr. Dorel Lucanu, Universitatea „Al. I. Cuza”, Iași, România
Prof. dr. Viorel Negru, Universitatea de Vest din Timișoara, România

Conf. univ. dr. Claudiu T. ARIEȘAN, *Magister Caeremoniae* al Universității de Vest din Timișoara

LAUDATIO
In honor of
Prof. Dr. Erika Ábrahám
upon awarding the title of
DOCTOR HONORIS CAUSA SCIENTIARUM

Honourable Rector,
Mr. President of the WUT Senate,
Members of the Academic Community,
Distinguished Guests,

The problem of satisfiability checking (SAT) of first order logic formulas is central in a wide variety of applications like, e.g., program verification and termination analysis, symbolic execution, test-case generation, program and controller synthesis, combinatorial optimisation, product design, planning and scheduling, machine learning, just to mention a few. Nowadays, SAT solvers can successfully solve huge industrial problems with millions of variables. Driven by this success, the scope was expanded to richer logics, and a new field of research has emerged: Satisfiability Modulo Theories (SMT) solving. Currently, SMT solving is widely used in many applications, including verification, synthesis, planning or product design automation.

We are privileged to honour today the presence and the achievements of a worldwide recognized scientist in the area of Formal Methods, who brought substantial contributions to the development and application of SAT and SMT solvers, and to the research of formal methods for probabilistic and hybrid systems.

Distinguished audience,

Erika Ábrahám completed her Computer Science studies with distinction at the Christian-Albrechts-University Kiel (Germany). She received her PhD from the University of Leiden (the Netherlands) for her work on the development and application of deductive proof systems for concurrent programs. In her postdoctoral years she moved to the Albert-Ludwigs University Freiburg (Germany), where she started to work on the development and application of SAT and SMT solvers. Since 2008, she is professor at RWTH Aachen University (Germany), with main research focus on SMT solving for real and integer arithmetic, and formal methods for probabilistic and hybrid systems.

Her research interests cover a wide area within formal methods, with the three main pillars being:

1. the automated solving of logical formulas, with focus on arithmetic theories, using satisfiability checking technologies,
2. the modeling and analysis of hybrid systems, whose behavior covers both continuous dynamics as well as discrete events, and
3. algorithms and tools for the synthesis and verification of systems with uncertain behavior, modeled using probability theory.

In the field of automated reasoning, Professor Erika Ábrahám made major contributions related to efficient solving of arithmetic equations. In this context, Professor Laura Kovacs from Technical University of Vienna emphasizes that:

"*Her work turns quantifier elimination approaches into efficient reasoning engines for solving satisfiability of (non-linear) arithmetic properties. Her recent extensions on solving linear real arithmetic problems, in particular in her FMpex approach, re-shaped the landscape of arithmetic reasoning. Efficiency of her work is demonstrated by her open-source SMT solver SMT-RAT, in which she brought "mathematical beauty" into "efficient heuristics" for symbolic computation in SMT solving techniques.*"

On the other hand, in his appreciation report Professor Dorel Lucanu from A.I. Cuza University of Iași wrote that:

"*Erika Ábrahám has also significant contributions to the field of Satisfiability Modulo Theories (SMT), especially on topics including quantifier-free non-linear real arithmetic, SMT problems involving real algebraic theories, SMT-based planning and scheduling. In summary, Erika Ábrahám's research covers both theoretical aspects and practical applications. Her work contributes to advancing the state of the art in all above-mentioned areas.*"

Her influential and impactful contributions in the field of hybrid systems allow the formal analysis of autonomous models, with applications to verification of cyber-physical systems. Her work captures system dynamics through differential equations and encodes system uncertainty via probabilistic actions. She pioneered research in the verification of probabilistic hyperproperties, as these properties are essential in ensuring security of stochastic systems. Her achievements include: Flow*, an analyzer for non-linear hybrid systems which combines reachability analysis with abstraction techniques, as well as the Taylor model of flow-pipe construction, which provides over-approximations of reachable sets for non-linear systems.

Professor Erika Ábrahám is very productive and well connected to the international scientific community. In national and international collaborations, she carried out 16 projects and co-authored 200 publications with 180 co-authors. Her scientometric profile can also be described

in the most eloquent terms, with more than 4800 citations, an i10 index of 91 and an h-index of 35, according to Google Scholar.

She is also a widely sought expert, with a number of presentations at top conferences, summer schools, or invited talks at academic institutions which is far beyond average. She gave more than 90 invited talks in top-notch formal methods events like ETAPS and CAV, and acted as co-organiser of 6 Dagstuhl Seminars. She served as a member in 8 Steering Committees and on more than 160 Program Committees. She co-chaired 21 conferences and workshops, served on four Editorial Boards, and reviewed project proposals for numerous national and international agencies like the European Commission, the DFG in Germany, the FFG, FWF and FEMtech in Austria, the NSERC in Canada, or the FCT in Portugal.

Erika Ábrahám is a great motivator of science and an initiator of new directions of research. In her keynote "Building bridges between symbolic computation and satisfiability checking" at ISSAC 2015, she emphasized the isolation of the communities of symbolic computation and satisfiability checking, and pointed out the potential that could be released by their connection. Her talk inspired the initiation of the project "SC2-Satisfiability Checking and Symbolic Computation – Uniting Two Communities to Solve Real Problems" which led to the creation of a joint community offering a platform for exchange and collaboration. It opened up many new research venues in symbolic computation and formal verification, establishing the project meeting into a prestigious publication venue in symbolic computation and formal verification. One of the most impactful results of Erika Ábrahám from this joint effort is the cylindrical algebraic covering method for solving real algebraic formulas, which adapts the ideas of the cylindrical algebraic decomposition method, and offers an alternative solution with reduced computational effort. The covering method has been implemented in the cvc5 SMT solver, which has won the SMT competition in 2022 in the category of quantifier-free real algebraic problems. She delivered excellent keynote talks at top tier venues in the area, notably at CAV 2024, LPAR 2024, ETAPS 2021 and IJCAR 2018.

Besides purely scientific aspects, Erika Ábrahám made strong contributions to strengthen the presence of women in computer science, at the European level for example in the working group WIRE of Informatics Europe, as a German representative in the COST Action Eugain, and at the local level as Deputy Equal Opportunities Officer at RWTH Aachen University. She gave numerous encouraging talks at PhD schools, and served as a mentor in different programs.

Moreover, Erika is a true role model for the young(er) generation. She is committed to improving gender balance and diversity in computer science, with her achievements so far being recognized with the Brigitte-Gilles award. In his appreciation report, Prof. Dr. James Davenport considers Erika a great role model who “*does a great deal to encourage girls and women in computer science*”.

Professor Erika Ábrahám is well acquainted with the scientific conferences and meetings organized at West University of Timișoara, especially with the conference Symbolic and Numeric Algorithms for Scientific Computing (SYNASC). She was invited speaker at SYNASC 2016; she gave a tutorial on SMT Solving for Arithmetic Theories at SYNASC 2017; and acted as co-chair at SYNASC 2019. Moreover, she established strong collaborations with members from the Computer Science department of West University of Timișoara, in the frame of two research projects funded at the European level: "*Automated Reasoning in the Classroom (ARC)*", a project within the EU Erasmus+ program that aims to enhance education in automated reasoning; and "*From zero to expert! Introducing the potential of AI and Robotics for all! (AiRobo)*", a project that aims to increase the level of competence and skills of the relevant academic staff in the field of AI-based Robotics.

Ladies and Gentlemen,

On the basis of the academic and scientific arguments and the evidence of exceptional professional expertise outlined above, the West University of Timișoara is honoured to award the title of Doctor Honoris Causa Scientiarum to Professor Erika Ábrahám from RWTH Aachen University.

I would also like to express my gratitude to the Rector and Senate of our university for the decision to honour her and to address to you, distinguished professor Erika Ábrahám our warmest congratulations and to wish you a long, successful career as researcher and teacher.

Prelegere
Prof. Dr. Erika Ábrahám
cu ocazia acordării titlului de
DOCTOR HONORIS CAUSA SCIENTIARUM
de către Universitatea de Vest din Timișoara

Eforturi comune pentru metodele formale

Mă simt mândră și onorată să primesc titlul de Doctor Honoris Causa din partea Universității de Vest din Timișoara (UVT). Îmi face plăcere să spun câteva cuvinte despre pregătirea mea științifică, despre interesele și activitățile noastre comune și despre ceea ce am realizat în trecut prin eforturi comune.

Am avut ocazia să lucrez împreună cu colegii de la UVT în proiecte științifice, care s-au concretizat în câteva publicații comune. Pentru a servi comunitățile noastre și pentru a impulsiona evoluțiile viitoare, am lucrat împreună în organizarea activității de cercetare și am preluat responsabilități în cadrul organizației Informatics Europe, atât în cadrul consiliului de administrație al acesteia, cât și în grupul de lucru WIRE. UVT este principala forță motrice a seriei de conferințe SYNASC, la care am adus, de asemenea, unele contribuții. În cele ce urmează amintesc mai întâi trecutul meu științific, înainte de a oferi mai multe detalii despre aceste colaborări.

Trecutul meu științific

În informatică, domeniul metodelor formale acoperă dezvoltarea și aplicarea de metode și instrumente riguroase din punct de vedere matematic pentru modelarea, sinteza și analiza sistemelor. Începând cu anii '60, metodele formale au adus contribuții inestimabile la crearea unor construcții matematice care au permis înțelegerea a ceea ce fac programele și la furnizarea de metode deductive pentru analiza semi-automatizată a programelor.

Acestea trebuie să fi fost vremuri interesante, cel puțin din perspectivă teoretică. Apoi, după prima epocă de entuziasm, au apărut voci critice. Existau îndoieli în principal cu privire la relevanța practică a metodelor formale, din cauza problemelor aparent insurmontabile legate de scalabilitate și automatizare completă [10].

În timpul doctoratului meu, la 35 de ani după lucrarea fundamentală a lui Hoare *The Axiomatic Basis of Computer Programming* [17], am lucrat la sisteme de demonstrare prin deducție pentru programe concurente. Mi-a luat ceva timp să descopăr că era mai mult decât „doar” verificarea programelor. Am fost copleșită de modul în care construcțiile matematice, atunci când sunt concepute în mod corect, au arătat eleganță și au deschis uși către o înțelegere mai profundă a

sistemelor examinate. Cu toate acestea, am constatat că programe concepute greșit generează reguli de verificare complexe și greu de înțeles, distrugând frumusețea abordării matematice.

În drumul meu spre a deveni cercetător independent, am dorit să-mi lărgesc profilul științific. Căutam subiecte provocatoare privind metodele formale, cu aspecte teoretice interesante, precum și aplicații practice cu impact, care nu erau încă bine cercetate. Au existat atât de multe domenii incredibil de interesante, încât am ajuns să fiu implicată în multe direcții de cercetare diferite, două dintre principalele domenii fiind metodele formale pentru sistemele probabiliste și pentru sistemele hibride. Comunitățile de metode formale mi s-au părut întotdeauna extrem de prietenoase și deschise, caracterizate printr-o puternică curiozitate științifică și oferind sprijin reciproc.

Mă simt profund recunoscătoare pentru că am avut privilegiul de a mă bucura de atât de multe discuții inspirate și colaborări fructuoase cu o mulțime de oameni extraordinari din întreaga lume (DBLP enumeră 181 de coautori ai mei), pentru că am avut ocazia de a răspândi entuziasmul pentru acest domeniu (de exemplu, în 92 de discuții invitate), dar și pentru că am avut onoarea de a servi comunitatea metodelor formale (de exemplu, în calitate de co-chair pentru 21 de evenimente și în 168 de comitete de program) și de a modela viitorul acesteia.

Verificarea satisfiabilității și calculul simbolic (SC-Square)

În timpul perioadei mele de postdoctorat, verificarea satisfiabilității [9] era deja un domeniu de cercetare puternic, care viza rezolvarea complet automatizată a formulelor logice (în principal fără cuantificatori). Instrumentele corespunzătoare, denumite Satisfiability Modulo Theory (SMT)-solvers [6], erau deja utilizate pe scară largă în numeroase aplicații: problemele din lumea reală cu componente combinatoriale pot fi codificate ca formule logice, iar solver-ele SMT pot fi utilizate pentru a identifica soluții (dacă există), care pot fi ulterior decodificate pentru a conduce la soluțiile problemei inițiale.

Solver-ele SMT erau deja disponibile pentru formulele aritmetice reale liniare, dar nu exista încă niciun suport pentru întreaga logică a aritmeticii reale (sau, folosind termeni matematici, algebra reală). Am fost fascinată de această problemă și, împreună cu primul meu grup de cercetare, am început să pătrundem în lumea calculului simbolic. Căutam algoritmi adecvați care erau implementați în sistemele de algebră computațională și care puteau fi adaptați și încorporați în instrumente de verificare a satisfiabilității pentru a rezolva probleme din aritmetica în domeniul numerelor reale.

Curând, am realizat că am subestimat în mod naiv dificultatea problemei. Pentru a înțelege metodele disponibile, a trebuit să pătrundem adânc în construcții matematice complexe, pentru care am solicitat ajutorul matematicienilor specialiști în calculul simbolic. Am realizat de asemenea că nu existau conexiuni stabilite între comunitatea de specialiști în verificarea satisfiabilității și cea din domeniul calculului simbolic pe care să le putem folosi pentru a solicita sprijin; pur și simplu, existau puține antecedente de colaborare și schimburi științifice. Pe de altă parte, am descoperit atât de multă frumusețe și eleganță în acest domeniu, încât m-am angajat pe deplin să continui pe această cale. Am început să dezvoltăm propriul nostru solver SMT numit SMT-RAT [13, 12]. După mai mult de 15 ani de cercetare și dezvoltare, acesta oferă acum implementări pentru aproape toți algoritmii exacți (complеți sau incomplеți) care sunt disponibili în prezent pentru rezolvarea problemelor aritmetice în domeniul numerelor reale.

În 2015, am fost invitată să susțin o prezentare la conferința ISSAC. În prezentarea intitulată *Building bridges between symbolic computation and satisfiability checking* [1], am subliniat legătura slabă dintre comunitățile de verificare a satisfiabilității și de calcul simbolic, în ciuda intereselor lor comune în anumite domenii. James H. Davenport, care a participat, de asemenea, la conferință, a sugerat să începem să inițiem conexiuni între aceste comunități. Aceasta a marcat nașterea inițiativei noastre de mare succes SC-Square [3], care a început sub forma unui proiect European de tip comunicare și acțiuni de suport, cu cercetători implicați și de la UVT. Dincolo de perioada de derulare a proiectului, comunitatea constituită prin SC-Square este încă activă și organizează un workshop anual pentru a menține conexiunile stabilite [22].

Chiar dacă ambele comunități împărtășesc interesul pentru aritmetica reală, ambele au viziunea lor individuală asupra problemei. Calculul simbolic se concentrează asupra structurilor matematice, în timp ce obiectivul principal în verificarea satisfiabilității este eficiența calculelor, folosind adesea explorarea cu o mare varietate de euristici de căutare dedicate. Probabil cel mai important rezultat al conexiunii lor a fost recunoașterea faptului că prin combinarea acestor două viziuni se poate ajunge nu numai la soluții mai eficiente, ci și la o mai bună înțelegere a problemei în sine.

Un rezultat deosebit de interesant al acestei colaborări este metoda acoperirii algebrice cilindrice (CAlC) [4], care își are rădăcinile în metoda descompunerii algebrice cilindrice (CAD) [11] din domeniul calculului simbolic, dar care îmbunătățește eficiența de calcul a CAD prin utilizarea unei strategii euristice de selecție ghidată, care este sensibilă la context și exploatează informațiile relevante la nivel local. Metoda CAlC reprezintă o îmbunătățire nu numai pentru găsirea de soluții, ci și pentru generarea de demonstrații în cazul problemelor nesatisfiabile, deoarece oferă o perspectivă mai clară și mai concentrată asupra cauzei nesatisfiabilității [5]. Din același motiv, eliminarea cuantificatorilor bazată pe CAlC [19] și-a demonstrat punctele forte prin câștigarea concursului SMT din acest an la categoria corespunzătoare.

Împreună modelăm viitorul metodelor formale

Cercetarea. În ceea ce privește dezvoltarea viitoare a metodelor formale, în [10], Dines Bjørner și Klaus Havelund au enumerat opt obstacole generale. Unul dintre acestea a fost absența convingerii că metodele formale vor ajunge vreodată să fie aplicate pentru probleme de dimensiuni industriale și, ca o consecință, absența convingerii că metodele formale merită să fie cercetate.

În ceea ce privește scalabilitatea, evoluțiile recente în domeniul verificării satisfiabilității oferă o demonstrație excelentă a faptului că unele domenii ale metodelor formale ajung să devină părți integrante ale sistemelor industriale (a se vedea, de exemplu, impresionanta prezentare *A Billion SMT Queries* a Day de Neha Rungta la CAV'22 [21]). Cu toate acestea, este necesar uneori să facem un pas înapoi și să combinăm sinergetic viziunea tradițională a metodelor formale cu alte moduri de gândire. Inițiativa noastră SC-Square este un exemplu excelent pentru o astfel de sinergie de succes.

Simpozionul internațional SYNASC (International Symposium on Symbolic and Numeric Algorithms for Scientific Computing), inițiat, organizat și găzduit de obicei de UVT, este un susținător constant al acestor evoluții, oferind condiții optime pentru comunicarea și schimbul științific. Sper că interacțiunile mele cu SYNASC au avut un impact pozitiv și i-au sporit vizibilitatea. Am susținut o prezentare invitată la SYNASC'16 [2] și un tutorial privind solver-ele

SMT la SYNASC'17 [7]. Împreună cu coautorii mei, am participat la mai multe ediții ale conferinței și am contribuit cu lucrări [18, 20]. În plus, am co-prezidat atelierul SC-Square'16, care a fost afiliat cu SYNASC'16. De asemenea, am fost implicat împreună cu colegii de la UVT în alte eforturi comune de a servi comunitățile noastre, cum ar fi proiectarea programului științific pentru simpozionul de doctorat la iFM'24 și o sesiune tematică CASC'16.

Simpozionul SYNASC este extrem de relevant pentru metodele formale nu numai datorită domeniului său actual, ci și datorită localizării sale geografice în sud-estul Europei. Din diverse motive, oamenii de știință din Europa de Sud și de Est sunt încă mai puțin implicați în rețelele științifice internaționale decât colegii lor vest-europeni; iar SYNASC joacă un rol central în intensificarea implicării acestora. Având rădăcini maghiare, este o chestiune de suflet și de importanță personală pentru mine să sprijin SYNASC pentru a-și atinge obiectivele, actorii din jurul SYNASC pentru a-și asuma roluri internaționale vizibile, precum și Universitatea de Vest din Timișoara pentru a-și spori vizibilitatea și reputația internațională.

Predarea. Chiar și fără a lua în considerare aplicabilitatea industrială, sunt convinsă că metodele formale merită investigate; din perspectivă educațională, studiul lor ajută la a antrena gândirea precisă, abstractă și analitică, sau pentru a ajuta la înțelegerea comportamentului sistemelor și pentru a clarifica ceea ce așteptăm de la ele.

La Universitatea din Aachen susțin în fiecare trimestru de iarnă un curs despre verificarea satisfiabilității. În ciuda complexității subiectului, acest curs este destul de popular în rândul studenților (oferim 350 de locuri și întotdeauna sunt ocupate toate locurile), iar anul acesta am fost onorată să primesc premiul departamental pentru predarea acestei discipline. Într-una dintre evaluările disciplinei, un student a scris că nu credea că îi place informatica teoretică, dar fiind obligat de planul de învățământ să urmeze și o disciplină teoretică a realizat cât de interesantă poate fi teoria și ulterior a dorit să aprofundeze acest subiect. Trebuie să îi învățăm pe studenți metodele formale într-o manieră motivantă (a se vedea, de exemplu, [8]), astfel încât să fie dispuși să adopte această viziune, nu numai sub formă de algoritmi și instrumente software, ci și ca mod de gândire și stil de lucru.

În cadrul proiectului ERASMUS+ *Automated Reasoning in the Class (ARC),* am colaborat cu UVT pentru a îmbunătăți stadiul actual al predării metodelor formale, cu accent pe raționamentul automat; acest lucru a dus la publicațiile comune [14, 15] și la cartea [16] publicată la Editura UVT. Recent, am demarat un alt proiect comun ERASMUS+ intitulat *Artificial intelligence based Robotics (AiRobo),* în cadrul căruia desfășurăm în comun activități de cercetare, precum și elaborarea de materiale didactice pentru acest subiect.

Gen și diversitate. Este deosebit de plăcut să văd studente interesate de metodele formale. Recunosc și nu pot sublinia îndeajuns importanța modelelor, cum ar fi profesoarele și oamenii de știință. De-a lungul întregii mele cariere, am contribuit continuu, în numeroase roluri, la îmbunătățirea echilibrului de gen și la sprijinirea diversității în informatică. Aici menționez doar activitatea comună cu colegii de la UVT în cadrul grupului de lucru WIRE (Women in Informatics Research and Education) al Informatics Europe, în vederea acordării premiului anual Minerva, care are ca scop recunoașterea și creșterea vizibilității activităților remarcabile din acest domeniu.

Activități precum mentoratul, conferințele despre cariera personală, participarea la interviuri, reprezentarea egalității de șanse etc. presupun un efort suplimentar, pe lângă activitatea zilnică, care rareori este recompensat. Aș dori să îmi exprim în mod explicit recunoștința față de toți cei care sunt angajați și dispuși să depună eforturi pentru îmbunătățirea echilibrului și a diversității de gen în domeniul metodelor formale și, în general, în informatică.

Sper ca legăturile mele cu Universitatea de Vest din Timișoara să continue să se dezvolte și să putem influența împreună viitorul metodelor formale pentru a-l face mai atractiv, mai de succes și cât mai divers.

Speech of
Prof. Dr. Erika Ábrahám
on the occasion of receiving the title of
DOCTOR HONORIS CAUSA SCIENTIARUM
of the West University of Timișoara

Joint Efforts for Formal Methods

I feel proud and honoured to receive the Honoris Causa Doctorate from the Universitatea de Vest din Timișoara (West University of Timisoara, UVT). It is my pleasure to say a few words about my scientific background, our shared interests and activities, and what we achieved in the past by joint effort.

I had the opportunity to work together with colleagues from UVT in scientific projects, which resulted in some joint publications. To serve our communities and to drive future developments, we worked together in scientific organisation and took over responsibilities within Informatics Europe, both on its board and in the WIRE working group. UVT is the main driving force for the SYNASC conference series, to which I also made some contributions. In the following I first recall my scientific background, before I provide more details about these collaborations.

My scientific background

In computer science, the area of formal methods covers the development and application of mathematically rigorous methods and tools for the modeling, synthesis and analysis of systems. Starting in the ’60s, formal methods made invaluable contributions to create mathematical constructs that allowed to understand what programs do, and to provide deductive methods for semi-automated program analysis.

These must have been exciting times, at least from the theoretical perspective. Then, after the first era of enthusiasm, critical voices were raised. Mainly, there was doubt about the practical relevance due to seemingly insurmountable problems with scalability and full automation [10].

During my PhD, 35 years after Hoare’s seminal work *The Axiomatic Basis of Computer Programming* [17], I worked on deductive proof systems for concurrent programs. It took some time for me to discover that it was more than “just” program verification. I was overwhelmed by how mathematical constructs, when designed the right way, showed elegance and opened doors to

a deeper understanding of the examined systems. However, mis-designed programming language constructs caused complex and hardly understandable proof rules in the proof system, destroying the beauty of the mathematical system.
On my path to become an independent researcher, I wanted to widen my scientific profile. I was searching for challenging formal methods topics, with interesting theoretical aspects as well as impactful practical applications, which were not well researched yet. There were so many incredibly interesting areas, that I ended up being involved in lots of different research threads, two of the main areas being formal methods for probabilistic and for hybrid systems. I always experienced the formal methods communities as exceptionally friendly and open, with strong scientific curiosity and mutual support. I feel deep gratitude to have had the privilege to enjoy so many inspiring discussions and fruitful collaborations with a lot of amazing people all over the world (DBLP lists 181 co-authors of mine), for having the opportunity to spread enthusiasm for this area (e.g. in 92 invited talks), but also to have the honour to serve the formal methods community (e.g. as Co-Chair for 21 events and serving on 168 Program Committees), and to shape its future.

Satisfiability Checking and Symbolic Computation (SC-Square)

During my postdoc time, satisfiability checking [9] was already a strong research area, aiming for the fully automated solution of (mostly quantifier-free) logical formulas. The corresponding tools, called satisfiability modulo theories (SMT) solvers [6], were already widely used in numerous applications: real-world problems with combinatorial components can be encoded as logical formulas, and SMT solvers can be used to identify solutions (if any), which can be decoded back to solutions of the given original problem.

SMT solvers were already available to solve linear real arithmetic formulas, but there was no support for the whole logic of real arithmetic (or, using mathematical terms, real algebra) yet. I was fascinated by the problem and, with my first group, started to delve into the world of symbolic computation. We were searching for suitable algorithms that were implemented in computer algebra systems and that could be adapted and embedded into satisfiability checking tools to solve real arithmetic problems.

On the one hand, I soon recognised that I naively under-estimated the hardness of the problem. To understand the available methods, we needed to dig deeply into complex mathematical constructs, for which we seeked help from mathematicians knowledgable in symbolic computation. However, there were no established connections between the communities of satisfiability checking and symbolic computation that we could use to reach out for support; there was simply little history of collaboration and exchange. On the other hand, I discovered so much beauty and elegance in this area that I was fully committed to continuing on this path. We started to develop our own SMT solver named SMT-RAT [13, 12]. After more than 15 years of research and development, it now

provides implementations for nearly all exact (complete or incomplete) algorithms that are currently available for solving real arithmetic problems.

In 2015, I was invited to give a keynote at the ISSAC conference. In my talk with the title *Building bridges between symbolic computation and satisfiability checking* [1], I emphasised the weak connection between the communities of satisfiability checking and symbolic computation, despite their common interests in certain areas. James H. Davenport, who also attended the conference, suggested that we start to initiate connections between these communities. This was the birth of our highly successful SC-Square initiative [3], which started in the form of a European Communication and Support Action, with engaged researchers involved also from UVT. Beyond its runtime, SC-Square is still active, and organises an annual workshop to maintain the established connections [22].

Even though both communities share interest for real arithmetic, they both have their individual view on the problem. Symbolic computation focuses on the mathematical structures, whereas the main goal in satisfiability checking is the efficiency of the computations, often using exploration with a wide variety of dedicated search heuristics. The perhaps most important outcome of their connection was the recognition, that combining these two views can result in not only more efficient solutions, but also to a better understanding of the problem itself.

To mention a specifically insightful outcome of this mutual inspiration, the cylindrical algebraic covering (CAlC) method [4] was proposed, which is rooted in the cylindrical algebraic decomposition (CAD) [11] method from the area of symbolic computation, but it improves the computational efficiency of CAD by employing a sample-guided heuristic exploration that allows the context-sensitive selection of locally relevant information. The CAlC method is not only an improvement for finding solutions, but in case of unsatisfiable problems also for proof generation, as it provides a more clear and focused view on the cause for unsatisfiability [5]. For the same reason, CAlC-based quantifier elimination [19] has demonstrated is strengths by winning this year's SMT competition in its respective category.

Together shaping the future of formal methods

Research. Regarding future development, in [10], Dines Bjørner and Klaus Havelund listed eight general obstacles to formal methods. One of them was the lack of belief that formal methods will ever scale to industrial size, and with that the lack of belief that formal methods are worthwhile investigating at all.

Regarding scalability, recent developments in satisfiability checking provide an excellent demonstration that some areas of formal methods do find their way to become integral parts of industrial systems (see e.g. the impressive keynote *A Billion SMT Queries a Day* by Neha Rungta

at CAV'22 [21]). However, this sometimes requires to take a step back and synergetically combine the traditional formal methods view with other ways of thinking. Our SC-Square initiative is an excellent example for such successful synergies.

The International Symposium on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC), initiated, organised and typically hosted by UVT, is a steady supporter of these developments by offering optimal conditions for scientific communication and exchange. I hope that my interactions with SYNASC made some positive impact and raised its visibility. I gave a keynote at SYNASC'16 [2] and a tutorial on SMT solving at SYNASC'17 [7]. Together with my co-authors, we attended several editions of the conference and contributed papers [18, 20]. Furthermore, I co-chaired the SC-Square'16 workshop, which was affiliated with SYNASC'16. I was also involved together with colleagues from UVT in further joint efforts to serve our communities, like designing the scientific program for the PhD Symposium at iFM'24 and a CASC'16 topical session.

The SYNASC symposium is highly relevant for formal methods not only due to its topical scope, but also through its geographical location in Southern-Eastern Europe. For diverse reasons, scientists in Southern and Eastern Europe are still less involved in international scientific networks than their West-European colleagues; and SYNASC plays a central role in intensifying their involvement. Having Hungarian roots, it is a matter of the heart and of personal importance to me to support SYNASC to achieve its goals, the actors around SYNASC to take over visible international roles, as well as the Universitatea de Vest din Timișoara to raise its visibility and international reputation.

Teaching. Even without considering industrial applicability, I am convinced that formal methods are unquestionably worthwhile investigating; alone for their educational role, for example to train precise, abstract and analytic thinking, or to help to understand the behaviour of systems and to clarify what we expect from them.

I give a lecture on satisfiability checking each winter term. Despite the complexity of the topic, it is quite popular among students (we offer 350 places, and it is always fully booked), and I was honoured this year to receive the departmental teaching award for teaching this lecture. In one of the lecture evaluations, a student wrote that they believed that they do not like theoretical computer science (but they needed to complete at least one theoretical subject). Through the lecture, however, they recognised how exciting theory can be and wanted to delve deeper. We need to teach the students formal methods in a motivating form (see e.g. [8]), such that they are willing to take up this view, not only in the form of algorithms and software tools, but also as a way of thinking and a style of working.

In the ERASMUS+ project on *Automated Reasoning in the Class (ARC)*, I collaborated with UVT to improve the state-of-the-art for teaching formal methods, with a focus on automated reasoning; this resulted in the joint publications [14, 15] and the book [16]. We recently started another common ERASMUS+ project on *Artificial intelligence based Robotics (AiRobo)*, where we jointly carry out research as well as develop teaching materials for this topic.

Gender and diversity. It is especially pleasing to see female undergraduate students interested in formal methods. I recognise and cannot stress enough the importance of role models, such as female teachers and scientists. Throughout my whole career, I continuously contributed in numerous roles to improve gender balance and to support diversity in computer science. Here I mention only the common work with colleagues from UVT in the WIRE (Women in Informatics Research and Education) working group of Informatics Europe, for its annual Minerva Award to increase the recognition and visibility of outstanding activities in this area.

Activities like mentoring, giving talks about personal career, participating in interviews, representing equal opportunities, etc. comes with additional effort, on top of the daily business, which is seldomly compensated by any means. I would like to explicitly express my recognition to all those who are committed and willing to invest effort for improving the gender balance and diversity in formal methods, and in general in computer science.

I hope that my connections to the West University of Timișoara continue growing, and that we can jointly impact the future of formal methods to make it more attractive, successful and diverse.

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8. Erika Ábrahám, Jasper Nalbach, and Valentin Promies. Automated exercise generation for satisfiability checking. In *Proc. of the 5th International Workshop on Formal Methods Teaching (FMTea'23)*, volume 13962 of LNCS, pages 1–16. Springer, 2023.
9. Armin Biere, Marijn Heule, Hans van Maaren, and Toby Walsh, editors. *Handbook of Satisfiability* - Second Edition, volume 336 of Frontiers in Artificial Intelligence and Applications. IOS Press, 2021.
10. Dines Bjørner and Klaus Havelund. 40 years of formal methods - Some obstacles and some possibilities? In *Proc. of the 19th International Symposium on Formal Methods (FM'14)*, volume 8442 of LNCS, pages 42–61. Springer, 2014.
11. George E. Collins. Quantifier elimination for real closed fields by cylindrical algebraic decomposition. In *Proc. of the 2nd GI Conference on Automata Theory and Formal Languages*, volume 33 of LNCS, pages 134–183. Springer, 1975.
12. Florian Corzilius, Gereon Kremer, Sebastian Junges, Stefan Schupp, and Erika Ábrahám. SMT-RAT: An open source C++ toolbox for strategic and parallel SMT solving. In *Proc. of the 18th International Conference on Theory and Applications of Satisfiability Testing (SAT'15)*, volume 9340 of LNCS, pages 360–368. Springer, 2015.
13. Florian Corzilius, Ulrich Loup, Sebastian Junges, and Erika Ábrahám. SMT-RAT: An SMT-compliant nonlinear real arithmetic toolbox. In *Proc. of the 15th International Conference on Theory and Applications of Satisfiability Testing (SAT'12)*, volume 7317 of LNCS, pages 442–448. Springer, 2012.
14. Isabela Drămnesc, Erika Ábrahám, Tudor Jebelean, Gábor Kusper, and Sorin Stratulat. Experiments with automated reasoning in the class. In *Proc. of the 15th International Conference on Intelligent Computer Mathematics*, volume 13467 of LNCS, pages 287–304. Springer, 2022.
15. Isabela Drămnesc, Erika Ábrahám, Tudor Jebelean, Gábor Kusper, and Sorin Stratulat. Automated reasoning in the class. *Computeralgebra Rundbrief*, 71:21–27, 2022.
16. Isabela Drămnesc, Tudor Jebelean, Erika Ábrahám, Sorin Stratulat, Gábor Kusper, Mircea Marin, Adrian Crăciun, Csaba Biró, Gergely Kovásznai, Nikolaj Popov, and Rebecca Haehn. Computational Logic: A Practical Approach. *Editura Universitatii de Vest, Timișoara*, 2023.
17. C. A. R. Hoare. An axiomatic basis for computer programming. *Communications of the ACM*, 12(10):576– 580, 1969.
18. Gereon Kremer, Erika Ábrahám, Matthew England, and James H. Davenport. On the implementation of ´ cylindrical algebraic coverings for satisfiability modulo theories solving. In

Proc. of the 23rd International Symposium on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC'21), pages 37–39. IEEE, 2021.

19. Gereon Kremer and Jasper Nalbach. Cylindrical algebraic coverings for quantifiers. In *Proc. of the 7th Satisfiability Checking and Symbolic Computation Workshop (SC-Square'22)*, volume 3458 of CEUR Workshop Proceedings, pages 1–9. CEUR-WS.org, 2022.
20. Lucas Michel, Jasper Nalbach, Pierre Mathonet, Na¨ım Z´ena¨ıdi, Christopher W. Brown, Erika Ábrahám, James H. Davenport, and Matthew England. On projective delineability. In *Proc. of the 26th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC'24)*. IEEE Computer Society, 2017.
21. Neha Rungta. A billion SMT queries a day. In *Proc. of the 34th International Conference on Computer Aided Verification (CAV'22)*, volume 13371 of LNCS, pages 3–18. Springer, 2022.
22. https://www.sc-square.org/workshops.html.

CURRICULUM VITAE

Erika Ábrahám

Univ.-Prof. Dr.

Department of Computer Science

RWTH Aachen University

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Education

Jan 2005	Ph.D. received from the University of Leiden, The Netherlands
Promotors:	Prof. W.-P. de Roever and Prof. J. N. Kok
Co-Promotors:	Prof. F. S. de Boer and Prof. M. Steffen
Feb 1999	Diploma received from the Christian-Albrechts-University of Kiel, Germany
Major/Minor:	Computer Science/Physics
Average mark:	1.0 (distinguishing award)

Positions

2013-today	Full professor, RWTH Aachen University, Germany

2008-2013	Head of the research group “Theory of Hybrid Systems”
2007-2008	Junior professor, RWTH Aachen University, Germany
2005-2007	Postdoctoral researcher, Jülich Research Centre, Germany
	Head of the junior research group “Theory of Hybrid Systems”
1999-2005	Ph.D. student, Christian-Albrechts-University Kiel, Germany

Selected publications

- Satisfiability checking

Jasper Nalbach, Erika Ábrahám, Philippe Specht, Christopher W. Brown, James H. Davenport and Matthew England: *Levelwise construction of a single cylindrical algebraic cell*. Journal of Symbolic Computation 123:102288, 2024. https://doi.org/10.1016/j.jsc.2023.102288

Erika Ábrahám, Gereon Kremer, James Davenport and Matthew England: *Deciding the consistency of non-linear real arithmetic constraints with a conflict driven search using cylindrical algebraic coverings*. Journal of Logical and Algebraic Methods in Programming 119:100633, Elsevier, 2021. https://doi.org/10.1016/j.jlamp.2020.100633

Erika Ábrahám: *Building bridges between symbolic computation and satisfiability checking*. Proc. of the 2015ACMon Int. Symp. On Symbolic and Algebraic Computation (ISSAC'15), pages 1-6, ACM,2015. https://doi.org/10.1145/2755996.2756636

- Hybrid systems

Stefan Schupp, Erika Ábrahám, Md Tawhid Bin Waez, Thomas Rambow and Zeng Qiu: *On the applicability of hybrid systems safety verification tools from the automotive perspective*. International Journal on Software Tools for Technology Transfer 26(1): 49-78 (2024). https://doi.org/10.1007/s10009-023-00707-0

Stefan Schupp, Erika Ábrahám, Ibtissem Ben Makhlouf and Stefan Kowalewski: *HyPro: A C++ library for state set representations for hybrid systems reachability analysis*. Proc. of the 9th NASA Formal Methods Symp. (NFM'17), Volume 10227 of LNCS, pages 288-294, Springer, 2017. https://doi.org/10.1007/978-3-642-39799-8 18

Xin Chen, Erika Ábrahám and Sriram Sankaranarayanan: *Flow*: An analyzer for non-linear hybrid systems*. Proc. of the 25th Int. Conf. on Computer Aided Verification (CAV'13), volume 8044 of LNCS, pages 258-263, Springer, 2013. https://doi.org/10.1007/978-3-642-39799-8_18

- Probabilistic systems

Christian Dehnert, Sebastian Junges, Nils Jansen, Florian Corzilius, Matthias Volk, Harold Bruintjes, Joost-Pieter Katoen and Erika Ábrahám: *PROPhESY: A probabilistic parameter synthesis tool*. Proc. of the 27th Int. Conf. on Computer Aided Verification (CAV'15), Volume 9206 of LNCS, pages 214-231,Springer, 2015. https://doi.org/10.1007/978-3-319-21690-4 13

- Green energy

Pascal Richter, David Laukamp, Levin Gerdes, Martin Frank and Erika Ábrahám: *Heliostat field layout optimization with evolutionary algorithms*. Proc. of the 2nd Global Conf. on Artificial Intelligence (GCAI'16), Volume 41 of EPiC Series in Computing, pages 240-252, EasyChair, 2016. https://doi.org/10.29007/7p6t

- Supercomputing

Markus Geimer, Felix Wolf, Brian J. N. Wylie, Erika Ábrahám, Daniel Becker and Bernd Mohr: *The Scalasca performance toolset architecture*. Concurrency and Computation: Practice and Experience 22(6):702-719, 2010. https://doi.org/10.1002/cpe.1556

- Deductive proof systems

Erika Ábrahám, Frank S. de Boer, Willem-Paul de Roever and Martin Steffen: An assertion- based proof system for multithreaded Java. Theoretical Computer Science 331(2-3):251-290,2005. https://doi.org/10.1016/j.tcs.2004.09.019

Project acquisition-running projects

AIRobo 2023-2026	*Artificial Intelligence based Robotics*. EU Erasmus+ KA220 Cooperation Partnerships for Higher Education
SMT-ART 2024-2026	*SMT Arithmetic Reasoning Techniques*. German Research Foundation (DFG)
RealySt 2022-2025	*Reachability Analysis for Stochastic Hybrid Systems*. German Research Foundation (DFG)
Sym4Dialog 2022-2025	*Simulations tool für den regionalen Dialog zum Ausbau erneuerbarer Energien*. IN4climate.NRW
REMARO 2020-2024	*Reliable AI for Marine Robotics*. EU Horizon2020 MSCA-ITN-ETN Marie-Sklodowska-Curie Innovative Training Network
UnRAVeL 2017-2026	*Uncertainty and Randomness in Algorithms, Verification and Logic*. Research Training Group, German Research Foundation (DFG)
EuroProofNet 2021-2025	*European Research Network on Formal Proofs* (COST Action CA20111, Management Committee member)
EUGAIN 2020-2024	*European Network for Gender Balance in Informatics* (COST Action CA19122, Management Committee Member)

Project acquisition-completed projects

Industrial project 2020-2022	*Digitalization and Energy Optimization in Buildings using Artificial Intelligence*. BMWi/DEOKI research project with the MeteoViva company

ARC 2020-2022	*Automated Reasoning in the Class.* EU Erasmus+ project (KA203 - Strategic Partnerships for Higher Education)
Industrial project 2018-2020	*Safety Verification for Mixed Discrete-Continuous Automotive Systems.* Research project with Ford
CAP 2015-2018	*Composition, Abstraction, and Parametrization for the Verification of Probabilistic and Hybrid Systems.* CDZ Sino-German cooperation project
Hy-Pro 2013-2016 2017-2018	*A Toolbox for the Reachability Analysis of Hybrid Systems using Geometric Approximations*. German Research Foundation (DFG), coordinator
Industrial project 2016-2018	*Simulink Formal Verification.* Industrial research project with Ford
Industrial project 2018	*SMT Solving for Configuration Management.* Industrial research project with Siemens
Industrial project 2018	*SMT Solving for Productline Optimisation*. Research project with Bosch
SC^2 2016-2018	*Satisfiability Checking and Symbolic Computation - Uniting Two Communities to Solve Real Problems.* H2020 FETOPEN CSA
SMT4ROB 2016-2017	*Optimizing the Performance of Robot Fleets in Production Logistics Scenarios Using SMT.* RWTH ICT Funds
SMT4ABS 2015-2016	*Combining SMT-Solving with Type Checking for Real-Time ABS Programs.* (German project coordinator) Norwegian-German DAAD ppp project
OASys 2012-2016	*Online Algorithms for Optimal Control of Hybrid Propulsion Systems (project coordinator).* German Research Foundation (DFG), coordinator
AlgoSyn 2011-2015 2015-2015	*Algorithmic Synthesis of Reactive and Discrete-Continuous Systems.* Research Training Group, German Research Foundation (DFG)*Modeling and Optimisation of Offshore Wind Farms.* RWTH Seed Funds
ROCKS 2009-2013	*Rigorous Dependability Analysis using Model Checking Techniques for Stochastic* Systems (German site coordinator) Dutch-German NWO-DFG bilateral cooperation program, German coordinator
CeBUG 2010-2013	*Counterexample Generation for Stochastic Systems using Bounded Model Checking*. German Research Foundation (DFG), coordinator
HySmart 2010-2011	*Hybrid Systems Modeling and Analysis with Rewriting Techniques* (German project coordinator) Norwegian-German DAAD ppp project

Awards, patents, spin-offs

Teaching award	of the Computer Science Department of RWTH Aachen University, June 2024
Brigitte-Gilles award	from RWTH Aachen University, for the development and execution of a program to improve gender balance in computer science
Guest professor	at TU Wien, March 2020
First place	SMT Competition 2020, category QF NIRA (quantifier-free non-linear mixed integer-real arithmetic)

First place	SMT Competition 2019, category QF NIRA (quantifier-free non-linear mixed integer-real arithmetic)
First place	SMT Competition 2018, category QF NIRA (quantifier-free non-linear mixed integer-real arithmetic)
First place	Planning and Execution Competition for Logistics Robots in Simulation 2018
Best paper award	CSI Int. Symp. on Computer Science and Software Engineering (CSSE'11)
Best presentation award	Int. Conf. on Engineering of Complex Computer Systems (ICECCS'01)
Distinguishing award	for Diploma thesis, Christian-Albrechts-University of Kiel, 1999
Patents	Method and system for controlling loads in a building (EP4145243A1) Steuerung einer Versorgungstechnik eines Gebäudes mittels eines neuronalen Netzwerks (RWTH-AZ 2567)
Spin-off	AixRays: Simulation and optimization solutions for central receiver systems

Invited talks and invited tutorials

1. *The Art of SMT Solving*, 36th International Conference on Computer Aided Verification (CAV'24), 07/2024
2. *On the Idea of Exploration-guided Satisfiability Checking*, International Conference on Logic for Programming, Artificial Intelligence and Reasoning (LPAR-25), 05/2024
3. *From Student to Professional: Challenges and Opportunities*, Cyber-Physical Systems and Internet- of-Things Week, 05/2024
4. *Research on the Theory of Hybrid Systems at RWTH Aachen University*, West University of Timisoara, 12/2023
5. *SMT: Something you Must Try*, 18th International Conference on integrated Formal Methods (iFM'23), 11/2023
6. *SMT: Something you Must Try*, Eindhoven University of Technology, 11/2023
7. *SMT Solving*, Shonan Seminar 178, 10/2023
8. *The Story of Undecidability*, Guest lecture at Keio University, 10/2023
9. *Seven Years of SC-Square*, 25th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC'23), 09/2023
10. *The Theory of Hybrid Systems*, Remaro PhD School, 09/2023
11. *Building Bridges between Symbolic Computation and Satisfiability Checking*, UnRAVeL Talk Series "Biggest Milestones - Research at Its Peak", 04/2023
12. *Automated Exercise Generation for Satisfiability Checking*, Formal Methods Teaching Workshop (FMTea'23), 03/2023
13. *I completed my Master! - And now? PhD as a career path for women in CS*, Interdisciplinary Symposium for Women in STEM Fields (ISINA'23), 03/2023
14. *Automated Exercise Generation for Satisfiability Checking*, Friedrich-Alexander-Universität Erlangen-Nürnberg, 03/2023
15. *Probabilistic Hyperproperties*, Lorentz Seminar on New Challenges in Programming Language Semantics, 11/2022
16. *SMT solving for Arithmetic Theories*, Conference on Intelligent Computer Mathematics (CICM'22), 09/2022
17. *Recent Advances for Hybrid Systems Verification with HyPro*, International Workshop on Numerical Software Verification (NSV'22), 08/2022

18. *Probabilistic Hyperproperties*, Workshop on Verification of Probabilistic Programs (VeriProP'22), 08/2022
19. *SMT Solving: Historical Review and New Developments*, Computability in Europe (CiE'22), 07/2022
20. *Recent Advances for Hybrid Systems Verification with HyPro*, International Workshop on Formal Engineering of Cyber-Physical Systems (FE-CPS@TASE'22), 07/2022
21. *Automatic Exercise Generation for Satisfiability Checking*, Formal Methods Europe (FME) Teaching Tutorials 07/2022
22. *Automatic Exercise Generation for Satisfiability Checking*, Training Event on Automated Reasoning in the Class (ARC), 07/2022
23. *SMT Solving: Past, Present and Future*, International Symposium on Theoretical Aspects of Soft- ware Engineering (TASE'22), 07/2022
24. *The Challenge of Compositionality for Stochastic Hybrid Systems*, UnRAVeL Research Training Group at RWTH Aachen University, 05/2022
25. *Delay Propagation in Railway Networks*, Workshop on Rigorous Dependability Analysis using Model Checking Techniques for Stochastic Systems (ROCKS'22), 05/2022
26. *How my Hobby Turned into being my Job*, Mentoring Workshop at ETAPS 2022, 04/2022
27. *Analysing Hybrid Systems with HyPro*, USC CCI-MHI Cyber-Physical Systems Seminar, Aarhus University, 11/2021
28. *Inspiration Talk*, Doctoral Symposium at the International Symposium on Formal Methods (PhD@FM'21), 11/2021
29. *Frauenmangel in technischen Fächern - wieso eigentlich?*, Days of Diversity, RWTH Aachen University, 11/2021
30. *SMT Solving: Past, Present and Future*, Informatics Europe Webinar, 10/2021
31. *SMT-based Planning - Some recent developments*, Workshop on Reliable AI for Marine Robotics: Challenges and Opportunities (REMARO@IROS'21), 10/2021
32. *SMT Solving: Past, Present and Future*, NASA Formal Methods Symp. (NFM'21), 05/2021
33. *Symbolic Computation Techniques in SMT Solving: Mathematical Beauty meets Efficient Heuristics*, Simons Institute at Berkeley, Seminar on SAT/SMT for Math and Computer Algebra Systems, 04/2021
34. *Reachability Analysis Techniques for Hybrid Systems*, European Joint Conferences on Theory and Practice of Software (ETAPS'21), 03/2021
35. *Abstract Domains in SMT Solving for Real Algebra*, Int. Workshop on Numerical and Symbolic Abstract Domains (NSAD'20), 11/2020
36. *Probabilistic Hyperproperties*, Int. Symp. on Games, Automata, Logics, and Formal Verification (GandALF'20), 09/2020
37. *Solving Real-Algebraic Formulas with SMT-RAT*, Int. Congress of Mathematical Software (ICMS'20), Braunschweig, Germany, 07/2020
38. *The Power of Satisfiability Checking*, TU Wien, Vienna, Austria, 03/2020
39. *Women in Computer Science*, Women in Computability at CiE'19, 07/2019
40. *Reachability Analysis Techniques for Hybrid Systems*, Summer School on Formal Methods for Cyber-Physical Systems, Verona, Italy, 06/2019
41. *Hybrid Systems Reachability Analysis, Open Problems in Concurrency Theory* (IFIP WG 1.8 at POPL'19), Cascais, Portugal, 01/2019

42. *Formal Verification of Automotive Simulink Controller Models: Empirical Technical Challenges, Evaluation and Recommendations,* 7th Int. Workshop on Cross-layer Resiliency (IWCR'19), Stuttgart, Germany, 07/2019.
43. *Women in Computer Science: Do We Still Need Equality Measures?,* Computing Is Too Important to Be Left to Men, Vienna, Austria, 12/2019.
44. SMT Solving: Matematikai szépség és informatikai hatékonyság, Debreceni ADA Konferencia (ADA'18), Debrecen, Hungary, 11/2018.
45. *Symbolic Computation Techniques in SMT Solving: Mathematical Beauty meets Efficient Heuristics*, 30th Nordic Workshop on Programming Theory (NWPT'18), Oslo, Norway, 10/2018.
46. *Symbolic Computation Techniques in SMT Solving: Mathematical Beauty meets Efficient Heuristics*, 9th Int. Joint Conf. on Automated Reasoning (IJCAR'18), Oxford, UK, 07/2018
47. *Old-established Methods in a New Look: How HyPro Speeds up Reachability Computations for Hybrid Systems*, IFAC Conf. on Analysis and Design of Hybrid System (ADHS'18), Oxford, UK, 07/2018
48. *Reachability Analysis Techniques for Hybrid Systems*, Summer School on Cyber-Physical Systems (CPS'18), Halmstad, Sweden, 06/2018
49. *SMT Solving for AI Planning: Theory, Tools and Applications*, 28th Int. Conf. on Automated Planning and Scheduling (ICAPS'18), Delft, The Netherlands, 06/2018
50. *Symbolic Computation Techniques in SMT Solving: Mathematical Beauty meets Efficient Heuristics*, FBK, Trento, Italy, 05/2018
51. *Frauen in der Informatik: Brauchen wir noch Gleichstellung?,* Gender x Informatik, Chemnitz, Germany, 05/2018
52. *The Informatics Europe Working Group Women in Informatics Research and Education*, Gender Action Webinar, 03/2018
53. *Symbolic Computation Techniques in SMT Solving*, Evening Seminar of the London Mathematical Society and the British Computer Society, London, UK, 11/2017
54. SMT Solving for Real Algebra, Int. Conf. on Mathematics and Informatics (MathInfo'17), Târgu Mures, Romania, 09/2017
55. *SMT Solving for Arithmetic Theories: Theory and Tool Support*, 19th Int. Symp. on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC'17), Timisoara, Romania, 09/2017
56. *Techniques and Tools for Hybrid Systems Reachability Analysis*, Int. Workshop on Formal Methods for Rigorous Systems Engineering of Cyber-Physical Systems (RISE4CPS), Heidelberg, Germany, 07/2017
57. *Divide and Conquer: Variable Set Separation in Hybrid Systems Reachability Analysis*, 15th Int. Workshop on Quantitative Aspects of Programming Languages and Systems (QAPL'17), Uppsala, Sweden, 04/2017
58. *Exploiting Symbolic Computation Techniques in SAT-Modulo-Theories Solving*, University of Waterloo, Waterloo, Canada, 03/2017
59. *Symbolic Computation Techniques in Satisfiability Checking*, Johannes Kepler University, RISC, Linz, Austria, 11/2016
60. *Combining Static and Runtime Methods to Achieve Safe Standing-Up for Humanoid Robots,* 6th Int. Symp. on Leveraging Applications of Formal Methods, Verification and Validation (ISoLA'16), Track: Static and Runtime Verification: Competitors or Friends?, Crete, Greece, 10/2016

61. *The Power of Satisfiability Checking*, European Computer Science Summit (ECSS'16), Budapest, Hungary, 10/2016
62. *Computation Techniques in SAT-Modulo-Theories Solving,* University of Kassel, Kassel, Germany, 10/2016
63. *Symbolic Computation Techniques in Satisfiability Checking,* 18th Symp. of Symbolic and Numeric Algorithms for Scientific Computing (SYNASC'16), Timisoara, Romania, 09/2016
64. *Satisfiability Checking: Theory and Applications,* 14th Int. Conf. on Software Engineering and Formal Methods (SEFM'16), Vienna, Austria, 07/2016
65. *SMT Solving for Non-Linear Arithmetic Theories,* IST Austria, Vienna, Austria, 05/2016
66. *Building Bridges between Symbolic Computation and Satisfiability Checking*, Int. Symp. of Symbolic and Algebraic Computation (ISSAC'15), Bath, UK, 07/2015
67. *A Greedy Approach for the Efficient Repair of Stochastic Controller Models, Abstraction and Synthesis of Correct-by-Construction Robotics Software: Reuniting Formal Methods with Model-Driven Software Engineering* (AbSynth'15), Workshop at Robotics Science and Systems (RSS'15), Rome, Italy, 07/2015
68. *Model Repair for Probabilistic Controller*, NII Shonan Meeting "Static Analysis meets Runtime Verification", Shonan Village Center, Japan, 03/2015
69. *Current Challenges in the Verification of Hybrid System*s, 5th Int. Workshop on Cyber Physical Systems (CyPhy'16), Amsterdam, The Netherlands, 10/2015
70. *Modeling and Verification of Hybrid Systems,* University of Genoa, Genoa, Italy, 10/2015
71. *Some Thoughts about Formal Methods in Robotics,* University of Genoa, Genoa, Italy, 10/2015
72. *SMT Solving for Real Arithmetic: What are the Challenges?,* CDZ Workshop "Computation and Reasoning with Constraints", Beijing, China, 11/2014
73. *Probabilistic Model Checking and Counterexample Generation*, IFIP WG2.2 Meeting on "Formal Description of Programming Concepts", Munich, Germany, 09/2014
74. *Reachability Analysis of Hybrid Systems,* INRIA, France, 06/2014
75. *Modeling and Analyzing Probabilistic Systems,* NVTI Theory Day, Utrecht, The Netherlands, 05/2014
76. *Reachability Analysis for Hybrid Systems*, Workshop on Computable Analysis and Rigorous Numerics, Maastricht, The Netherlands, 12/2013
77. *Formal Methods for Hybrid Systems,* University of Passau, Passau, Germany, 11/2013
78. *Modeling and Analysis of Hybrid Systems,* Formal Description of Programming Concepts (IFIP Working Group 2.2), Lisbon, Portugal, 09/2013
79. *Reachability Analysis for Hybrid Systems*, CDZ Workshop on "Probabilistic and Hybrid System Verification", Beijing, China, 09/2013
80. *Computing Counterexamples for Discrete-Time Probabilistic Systems,* ROCKS Autumn School "Rigorous Dependability Analysis for Stochastic Systems", Vahrn, Italy, 10/2012
81. *Hybrid Systems,* University of Twente, Enschede, The Netherlands, 08/2012
82. *SMT Solving Mechanisms for Non-Linear Real Arithmetic,* Albert-Ludwigs-University, Freiburg, Germany, 05/2012
83. *Heap-abstraction for a Multi-Threaded Object-Oriented Calculus*, Workshop on Automata and Logic for Data Manipulating Programs (LIAFA'10), Paris, France, 12/2010
84. *SMT-Solving for the Reals,* University of Karlsruhe, Germany, 09/2010
85. *SMT-Solving in the Verification and Synthesis of Hybrid Syste*ms, University of Freiburg, Germany, 07/2010

86. *A Lazy SMT-Solver for a Non-Linear Subset of Real Algebra*, Dagstuhl Seminar "Verification over Discrete-Continuous Boundaries", Dagstuhl, Germany, 07/2010
87. *SMT-Solving for the First-Order Theory of the Reals*, Dagstuhl Seminar "Algorithms and Applications for the Next Generation of SAT Solvers", Dagstuhl, Germany, 11/2009
88. *SAT-Modulo-Theories Solving in the Context of Bounded Model Checking*, CWI Amsterdam, Amsterdam, The Netherlands, 06/2009
89. *SMT-solving in the Context of Bounded Model Checking*, University of Oslo, Oslo, Norway, 04/2009
90. *Heap-Abstraction for an Object-Oriented Calculus with Thread Classes*, Computability in Europe (CiE'06), Swansea, Great Britain, 07/2006
91. *A Proof System for Exception Handling in Multithreaded Java*, Christian-Albrechts University, Kiel, Germany, 05/2004
92. *Verification for Java's Monitor Concept*, Int. Symp. on Formal Methods for Components and Objects (FMCO'02), Leiden, The Netherlands, 11/2002

Organization of scientific events (since 2014)

- **Co-organiser** Dagstuhl Seminar *Integrated Rigorous Analysis in Cyber-Physical Systems Engineering*, Dagstuhl, Germany, 01/2023
- **Co-organiser** IPAM Workshop *Machine Assisted Proofs*, Los Angeles, USA, 02/2023
- **Co-organiser** Dagstuhl *Seminar New Perspectives in Symbolic Computation and Satisfiability Checking*, Dagstuhl, Germany, 02/2022
- **Co-organiser** 4th Workshop *Women in Informatics Research and Education*, online, 10/2020
- **Co-organiser** 2nd Workshop *Women in Informatics Research and Education*, Rome, Italy, 10/2018
- **Co-organiser** Summer School *Satisfiability Checking and Symbolic Computation*, Saarbrücken, Germany, 07-08/2017
- **Co-organiser** 1st Workshop *Women in Informatics Research and Education*, Gothenburgh, Sweden, 10/2017
- **Co-organiser** Dagstuhl *Seminar Computer-Assisted Engineering for Robotics and Autonomous Systems*, Dagstuhl, Germany, 02/2017
- **Co-organiser** *Festschrift and Celebration Event for Frank de Boer's 60th Birthday*, Eindhoven, the Netherlands, 04/2016
- **Co-organiser** GI-Dagstuhl Seminar *Formal Evaluation of Critical Infrastructures*, Dagstuhl, Germany, 12/2015
- **Co-organiser** Dagstuhl Seminar *Symbolic Computation and Satisfiability Check*ing, Dagstuhl, Germany, 11/2015
- **Co-organiser** Dagstuhl Seminar *Randomized Timed and Hybrid Models for Critical Infrastructures*, Dagstuhl, Germany, 01/2014 (41 participants)
- **Organiser** of several workshops (see section Program Committee co-chair below)

Scientific society memberships

- Since 2009: Member of the *German Association of University Professors and Lecturers* (DHV)
- Since 2009*:* Member of the *German Informatics Society* (GI)

- Since 2013: Member of the *Computability in Europe* (CiE) Association

Steering Committee memberships

- **QEST** (2022-2025): Int. Conf. on Quantitative Evaluation of SysTems
- **SMT** (2018-2022): Int. Workshop on Satisfiability Modulo Theories
- **GE@ICSE** (since 2018): Workshop on Gender Equality in Software Engineering
- **SNR** (since 2017): Int. Workshop on Symbolic and Numerical Methods for Reachability Analysis
- **iFM** (since 2016): Int. Conf. on integrated Formal Methods
- **SC²** (2016-2019): Int. Workshop on Satisfiability Checking and Symbolic Computation
- **FORTE** (2014-2017): IFIP Int. Conf. on Formal Techniques for Distributed Objects, Components and Systems
- **ETAPS** (2013-2014): European Joint Conferences on Theory and Practice of Software

Program Committee co-chair

1. Int. Conf. on Runtime Verification (**RV'24**)
2. ACM Int. Conf. on Hybrid Systems: Computation and Control (**HSCC'24**)
3. Int. Colloquium on Theoretical Aspects of Computing (**ICTAC'23**)
4. Int. Workshop on Satisfiability Checking and Symbolic Computation (**SC²'23**)
5. Int. Conf. on Fundamentals of Software Engineering (**FSEN'23**)
6. Software Verification and Testing Track at the ACM Symp. on Applied Computing (**SVT-SAC'22**)
7. Conf. on Quantitative Evaluation of SysTems (**QEST'22**)
8. Software Verification and Testing Track at the ACM Symp. on Applied Computing (**SVT-SAC'21**)
9. Industry Day at Formal Methods (**Industry@FM'21**)
10. Session on Real Algebraic Geometry at the Int. Congress on Mathematical Software (**ICMS'20**)
11. Int. Symp. on Symbolic and Numeric Algorithms for Scientific Computing (**SYNASC'18**)
12. Pre-Summit Workshop for Deans and Department Heads at the European Computer Scienc eSummit (**ECSS'18**)
13. PhD Symp. at iFM'18 on Formal Methods: Algorithms, Tools and Applications (**PhD-iFM'18**)
14. Workshop on Gender Equality in Software Engineering (**GE@ICSE'18**)
15. PhD Symp. at iFM'17 on Formal Methods: Algorithms, Tools and Applications (**PhD-iFM'17**)
16. Int. Workshop on Symbolic and Numerical Methods for Reachability Analysis (**SNR'17**)
17. Int. Conf. on integrated Formal Methods **(iFM'16**)
18. Int. Workshop on Satisfiability Checking and Symbolic Computation (**SC2'16**)
19. Int. Workshop on Symbolic and Numerical Methods for Reachability Analysis (**SNR'16**)
20. IFIP Int. Conf. on Formal Techniques for Distributed Objects, Components and Systems (**FORTE'14**)
21. Int. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (**TACAS'14**)

Further reviewing activities

- Guest editor for several journal special issues
- Since 2021: Editorial board member for *Transactions on Computational Logic* (*ToCL*)
- Since 2018: Editorial board member for *Progress in Computer Science and Applied Logic* (*PCSAL*)
- 2021-2023: Editorial board member *Formal Methods in System Design* (*FMSD*)
- 2022-2023: Editorial board member *Nonlinear Analysis: Hybrid Systems* (*NAHS*)
- 2024: Member of the Evaluation Panel for the R&D Units Multiannual Funding Program of the Portuguese national public funding agency *Fundaçao para a Ciência e a Tecnologia* (*FCT*)
- 2020-2021: Member of the Evaluation Panel for INRIA Project Teams
- 2018: Member of the NSERC (Natural Sciences and Engineering Research Council of Canada) Evaluation Group for Computer Science
- Further project reviews: European Commission; German Research Foundation (DFG), Germany; Bavarian Research Institut for Digital Transformation (bidt), Germany; FFG, Austria; Stadt Wien, Austria; FWF, Austria; Linz Institute of Technology, Austria; FEMtech, Austria; Scientific Council of the Institut Pascal, France; City University of Hong Kong, China; Israel Science Foundation; Natural Sciences and Engineering Research Council of Canada (NSERC), Canada
- Book reviewer for Springer International Publishing
- Reviewer for numerous journals (computer science, mathematics)

Commission work

Since 2024	Board member of the German Association of University Professors and Lecturers (Deutscher Hochschulverband, DHV), Region Aachen
Since 2017	Representative of the German Informatics Society at the Fachgruppe Computeralgebra
2018-2019	Board member Informatics Europe
Since 2017	Member and 2018-2019 leader of the Informatics Europe Working Group *Women in Informatics Research and Education*
2016	Jury member for the 2016 *Minerva Informatics Equality Award*
Since 2012	Deputy equal opportunity commissioner of the RWTH Aachen University Speaker of the young scientists at RWTH Aachen University
2010-2011	Speaker of the young scientists at RWTH Aachen University
Since 2008	Member of different commissions at RWTH Aachen University

Supervision of PhD students

Current supervision:	László Antal, Lina Gerlach, József Kovács, Jasper Nalbach, Valentin Promies, Nicolai Radke (RWTH Aachen University, Aachen, Germany)
Graduated 10/2022:	Rebecca Haehn (RWTH Aachen University, Aachen, Germany)

Graduated 05/2020:	Francesco Leofante (cotutelle: RWTH Aachen University, Aachen, Germany and Università di Genova, Genoa, Italy) *Optimal Planning Modulo Theories*
Graduated 03/2020:	Gereon Kremer (RWTH Aachen University, Aachen, Germany) *Cylindrical Algebraic Decomposition for Nonlinear Arithmetic Problems*
Graduated 09/2019:	Stefan Schupp (RWTH Aachen University, Aachen, Germany) *State Set Representations and their Usage in the Reachability Analysis of Hybrid Systems*
Graduated 12/2018:	Ulrich Loup (RWTH Aachen University, Aachen, Germany) *On Solving Real-algebraic Formulas in a Satisfiability-Modulo-Theories Framework*
Graduated 12/2016:	Johanna Nellen (RWTH Aachen University, Aachen, Germany) *Analysis and Synthesis of Hybrid Systems in Control Engineering*
Graduated 04/2015:	Florian Corzilius (RWTH Aachen University, Aachen, Germany) *Integrating Virtual Substitution into Strategic SMT Solving*
Graduated 04/2015	Daniela Lepri (University of Oslo, Oslo, Norway) *Timed Temporal Logic Model Checking of Real-Time Systems – A Rewriting-Logic-Based Approach*
Graduated 03/2015:	Xin Chen (RWTH Aachen University, Aachen, Germany) *Reachability Analysis of Non-Linear Hybrid Systems Using Taylor Models*
Graduated 03/2015:	Nils Jansen (RWTH Aachen University, Aachen, Germany) *Counterexamples in Probabilistic Verification*
Graduated 09/2014:	Muhammad Fadlisyah (University of Oslo, Oslo, Norway) *A Rewriting-Logic-Based Approach for the Formal Modeling and Analysis of Inter- acting Hybrid Systems*

Evaluation commissions

Ph.D. reviewer:

Birgit van Huijgevoort, Eindhoven University of Technology, 2023
Peter Varnai, KTH Royal Institute of Technology, 2022
Guillaume Dupont, National Polytechnic Institute, Toulouse, France, 2021
Vicktorio El Hakim, University of Twente, the Netherlands, 2021
Andreas Humenberger, TU Wien, Austria, 2021
Carina Pilch, TU Münster, Germany, 2021
Anton Pirogov, RWTH Aachen University, Germany, 2021
Siham Khoussi, Verimag Grenoble, France, 2021
Shukun Tokas, University of Oslo, Norway, 2021
Jannik Hüls, University of Münster, Germany, 2020
Andrei Sandler, University of Hertfordshire, UK, 2020
Bruto Da Costa Antonio Anastasio, Indian Institute of Technology Kharagpur, India, 2020
Bjornat Luteberget, University of Oslo, Norway, 2019

Braham Lotfi Mediouni, Université Grenoble-Alpes, France
Leonhard Asselborn, University of Kassel, Germany, 2018
Ahmed Irfan, University of Trento, Italy, 2018
Hadi Zaatiti, University Paris-Sud, France, 2018
Ayman Aljarbouh, INRIA Rennes / IRISA, France, 2017
Haniel Barbose, INRIA Nancy, France, 2017
Curtis Bright, University of Waterloo, Canada, 2017
Christian Meirich, RWTH Aachen University, Germany, 2017
Yuliia Romenska, VERIMAG Grenoble, France, 2017
Niloofar Safiran, RWTH Aachen University, Germany, 2017
Souha Ben-Rayana, VERIMAG Grenoble, France, 2016
Crystal Din, University of Oslo, Norway, 2014
Georgeta Igna, University of Nijmegen, the Netherlands, 2013
Melanie Winkler, RWTH Aachen University, Germany, 2013
Romain Testylier, VERIMAG Grenoble, France, 2013

Appointment and habilitation committees:

École Polytechnique, France (2024); Aalborg University, Denmark (2024); University of Bath, UK (2024); University of Hildesheim, Germany (2024); École Polytechnique, France (2024); University of Grenoble, France (2023); Karlsruhe Institute of Technology, Germany (2022); University of Braunschweig, Germany (2022); University of Bremen, Germany (2022), KIT, Germany (2021); University of Cyprus (2021); Western Norway University of Applied Sciences (2021); Universität Oldenburg, Germany (2019); University of Halmstad (2019); TU Wien, Austria (2019); TU München, Germany (2019); MPI Saarbrücken, Germany (2019); Chalmers University of Technology, Sweden (2018); Radboud University Nijmegen, the Netherlands (2016); University of Twente, the Netherlands (2015- 2016); Aarhus University, Denmark (2013-2014); RWTH Aachen University, Germany (numerous since 2008)

Teaching since 2008

Bachelor/Master at RWTH Aachen University:

Annually since 2009 (each winter term)	Lecture on *Satisfiability Checking* (200-350 students) Average evaluation: 1.5 (scale 1-5 with 1 being the best)
Annually since 2010 (each summer term)	Lecture on Modeling and Analysis of Hybrid Systems (150-250 students) Average evaluation: 1.6 (scale 1-5 with 1 being the best)
Each semester	*Seminars and practical courses*
Summer term 2014	*Data Structures and Algorithms* (~600 students) Average evaluation: 1.7 (scale 1-5 with 1 being the best)
Winter term 2017/18	Bridging Course *Foundations of Informatics*
Summer term 2020	*Algorithms and Data Structures (Service)* (~150 students)

Doctoral studies:

08/2024	One-day tutorial *SMT Solving* at the Marktoberdorf Summer School, Marktoberdorf, Germany
09/2022	One-day tutorial *SMT Solving* at the Summer School of the European Research Training Network on Reliable AI for Marine Robotics (REMARO), Aachen, Germany
07/2022	One-day tutorial *Understanding and Using SMT Solving* at the Summer School on Automated Reasoning in the Class (ARC), Linz, Austria
03/2020	10-days doctoral course *Reachability Analysis Techniques for Hybrid Systems* at TU Wien, Austria
06/2018	Half-day *tutorial Reachability Analysis Techniques for Hybrid Systems* at the 2018 Summer School on Cyber-physical Systems, Halmstad, Sweden
09-10/2017	Doctoral course *Modeling and Analysis of Hybrid Systems* at the University of Szeged, Hungary
10/2015	Doctoral course *Formal Methods for Hybrid Systems* at the University of Genoa, Italy
06/2014	Half-day tutorial *Probabilistic Modeling and Model Checking* at the Int. School on Formal Methods for the Design of Computer, Communication and Software Systems: Executable Software Models (SFM-14:ESM), Bertinoro, Italy

High-school activities:

1. *Organisation of annual events for high-school students:* Lecture series “What is Computer Science?”, Summer University, Aachen Computer Science Days
2. *Contribution to different events for pupils and high-school students*: Girls’ Day, Helle Kopfe, Cybermentor

Publications of Erika Ábrahám

Theses

1. Erika Ábrahám. *An Assertional Proof System for Multithreaded Java - Theory and Tool Support*. PhD thesis, University of Leiden, 2005.
2. Erika Ábrahám-Mumm. *Bestimmung der Gesichtspose mit künstlichen neuronalen Netzen*. Master’s thesis, Institut für Informatik und Praktische Mathematik, Christian-Albrechts-Universität zu Kiel, 1998.

Books and edited proceedings

1. Erika Ábrahám, Stefan Hallerstede, John Hatcliff, Danielle Stewart, and Noah Abou El Wafa. *Integrated Rigorous Analysis in Cyber-Physical Systems Engineering* (Dagstuhl Seminar 23041). Dagstuhl Reports, 13(1):155–183, 2023.
2. Isabela Drămnesc, Tudor Jebelean, Erika Ábrahám, Sorin Stratulat, Gábor Kusper, Mircea Marin, Adrian Crăciun, Csaba Biró, Gergely Kovásznai, Nikolaj Popov, and Rebecca Haehn. *Computational Logic: A Practical Approach*. Editura Universitătii de Vest, Timisoara, 2023.
3. Hossein Hojjat and Erika Ábrahám, editors. *Proc. of the 10th Int. Conf. on Fundamentals of Software Engineering (FSEN'23)*, volume 14155 of LNCS. Springer-Verlag, 2023.
4. Erika Ábrahám, Clemens Dubslaff, and Silvia Lizeth Tapia Tarifa, editors. *Proc. of the 20th Int. Symp. on Theoretical Aspects of Computing (ICTAC'23)*, volume 14446 of LNCS. Springer-Verlag, 2023.
5. Erika Ábrahám and Thomas Sturm, editors. *Proc .of the 8th SC-Square Workshop (SC-Square@ISSAC'23)*, volume 3455 of CEUR Workshop Proceedings. CEUR-WS.org, 2023.
6. Erika Ábrahám, James H. Davenport, Matthew England, and Alberto Griggio. *New Perspectives in Symbolic Computation and Satisfiability Checking* (Dagstuhl Seminar 22072). Dagstuhl Reports, 12(2):67–86, 2022.
7. Erika Ábrahám and Marco Paolieri, editors. *Proc. of the 19th Int. Conf. on Quantitative Evaluation of Systems (QEST'22)*, volume 13479 of LNCS. Springer-Verlag, 2022.
8. Erika Ábrahám and Silvia Lizeth Taipa Tarifa, editors. *Proc. of the PhD Symp. at iFM'18 on Formal Methods: Algorithms, Tools and Applications (PhD-iFM'18)*. Research report 483, August 2018, University of Oslo, 2018.
9. Erika Ábrahám and Sergiy Bogomolov, editors. *Proc. of the 3rd Int. Workshop on Symbolic and Numerical Methods for Reachability Analysis (SNR'17),* volume 247 of Electronic Proceedings in Theoretical Computer Science, 2017.
10. Erika Ábrahám, Hadas Kress-Gazit, Lorenzo Natale, and Armando Tacchella. *Computer-Assisted Engineering for Robotics and Autonomous Systems* (Dagstuhl Seminar 17071). Dagstuhl Reports, 7(2):48–63, 2017.
11. Erika Ábrahám and Marieke Huisman, editors. *Proc. of the 12th Int. Conf. on Integrated Formal Methods (iFM'16)*, volume 9681 of LNCS. Springer-Verlag, 2016.
12. Erika Ábrahám, James H. Davenport, and Pascal Fontaine, editors. *Proc. of the 1st Workshop on Satisfiability Checking and Symbolic Computation (SC^2 2016)*, volume 1804 of CEUR Workshop Proceedings. CEUR-WS.org, 2017.
13. Erika Ábrahám and Sergiy Bogomolov, editors. *Proc. of the 2016 Int. Workshop on Symbolic and Numerical Methods for Reachability Analysis (SNR'16)*. IEEE Computer Society, 2016.
14. Erika Ábrahám, Marcello M. Bonsangue, and Einar Broch Johnsen, editors. *Theory and Practice of Formal Methods - Essays Dedicated to Frank de Boer on the Occasion of His 60th Birthday*, volume 9660 of LNCS. Springer-Verlag, 2016.
15. Erika Ábrahám, Pascal Fontaine, Thomas Sturm, and Dongming Wang. *Symbolic Computation and Satisfiability Checking (Dagstuhl Seminar 15471)*. Dagstuhl Reports, 5(11):71–89, 2015.
16. Erika Ábrahám and Klaus Havelund, editors. *Proc. of the 20th Int. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'14)*, volume 8413 of LNCS. Springer-Verlag, 2014.

17. Erika Ábrahám and Catuscia Palamidessi, editors. *Proc. of the 34th IFIP WG 6.1 Int. Conf. on Formal Techniques for Distributed Objects, Components, and Systems (FORTE'14)*, volume 8461 of LNCS. Springer-Verlag, 2014.
18. Erika Ábrahám, Alberto Avritzer, Anne Remke, and William H. Sanders. *Randomized Timed and Hybrid Models for Critical Infrastructures (Dagstuhl Seminar 14031).* Dagstuhl Reports, 4(1):36–82, 2014.

Invited publications

1. Erika Ábrahám, József Kovács, and Anne Remke. SMT: Something you Must Try. In *Proc. of the 18th Int. Conf. on integrated Formal methods (iFM'23)*, volume 14300 of LNCS, pages 3–18. Springer-Verlag, 2023.
2. Erika Ábrahám, Jasper Nalbach, and Valentin Promies. Automated exercise generation for satisfiability checking. In *Proc. of the 5th Int. Workahop on Formal Methods Teaching (FMTea'23)*, volume 13962 of LNCS, pages 1-16. Springer-Verlag, 2023.
3. Erika Ábrahám. Symbolic computation techniques in SMT solving: Mathematical beauty meets efficient heuristics (abstract). In *Proc. of the 9th Int. Joint Conf. on Automated Reasoning (IJCAR'18)*, volume 10900 of LNCS, page XII. Springer-Verlag, 2018.
4. Stefan Schupp, Johanna Nellen, and Erika Ábrahám. Divide and conquer: Variable set separation in hybrid systems reachability analysis. In *Proc. of the 15th Workshop on Quantitative Aspects of Programming Languages and Systems (QAPL'17),* volume 250 of Electronic Proceedings in Theoretical Computer Science, pages 1–14. Open Publishing Association, 2017.
5. Francesco Leofante, Erika Ábrahám, Tim Niemueller, Gerhard Lakemeyer, and Armando Tacchella. On the synthesis of guaranteed-quality plans for robot fleets in logistics scenarios via optimization modulo theories. In *Proc. of the 2017 IEEE Int. Conf. on Information Reuse and Integration (IRI'17)*, pages 403–410. IEEE Computer Society, 2017.
6. Erika Ábrahám and Gereon Kremer. SMT solving for arithmetic theories: Theory and tool support. In *Proc. of the 19th Int. Symp. on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC'17)*, pages 1–8. IEEE Computer Society, 2017.
7. Erika Ábrahám and Gereon Kremer. Satisfiability checking: Theory and applications. In *Proc. of the 14th Int. Conf. on Software Engineering and Formal Methods (SEFM'16),* volume 9763 of LNCS, pages 9–23. Springer-Verlag, 2016.
8. Erika Ábrahám. Symbolic computation techniques in satisfiability checking. In *Proc. of the 18th Int. Symp. on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC'16)*, pages 3–10. IEEE Computer Society, 2016.
9. Erika Ábrahám and Klaus Havelund. Some recent advances in automated analysis. *Software Tools for Technology Transfer*, 18(2):121–128, 2016.
10. Stefan Schupp, Erika Ábrahám, Xin Chen, Ibtissem Ben Makhlouf, Goran Frehse, Sriram Sankara-Narayanan, and Stefan Kowalewski. Current challenges in the verification of hybrid systems. In Proc. of the 5th Workshop on Design, Modeling, and Evaluation of Cyber Physical Systems (CyPhy'15), volume 9361 of Information Systems and Applications, incl. Internet/Web, and HCI, pages 8–24. Springer-Verlag, 2015.
11. Erika Ábrahám. Building bridges between symbolic computation and satisfiability checking. In *Proc. of the 2015 ACM on Int. Symp. on Symbolic and Algebraic Computation (ISSAC'15)*, pages 1–6. ACM, 2015.

12. Erika Ábrahám, Bernd Becker, Christian Dehnert, Nils Jansen, Joost-Pieter Katoen, and Ralf Wimmer. Counterexample generation for discrete-time Markov models: An introductory survey (invited contribution). In Proc. of the 14th Int. School on Formal Methods for the Design of Computer, Communication, and Software Systems (SFM'14), volume 8483 of LNCS, pages 65–121. Springer-Verlag, 2014.
13. Ralf Wimmer and Erika Ábrahám. Maybe or maybe not: Contributions to stochastic verification. In *Aspekte der Technischen Informatik: Festschrift zum 60. Geburtstag von Bernd Becker*, pages 119–127. MV-Verlag, 2014.
14. Johanna Nellen and Erika Ábrahám. A CEGAR approach for the reachability analysis of PLC-controlled chemical plants. In *Proc. of the 15th IEEE Int. Conf. on Information Reuse and Integration (IRI'14),* pages 500–507. IEEE Computer Society, 2014.
15. Sriram Sankaranarayanan, Xin Chen, and Erika Ábrahám. Lyapunov function synthesis using Handelman representations. In *Proc. of the 9th IFAC Symp. on Nonlinear Control Systems (NOLCOS'13)*, pages 576–581. IFAC-PapersOnLine, 2013.
16. Erika Ábrahám, Andreas Grüner, and Martin Steffen. Heap-abstraction for an object-oriented calculus with thread classes. In Proc. of the 2nd Conf. on Computability in Europe: Logical Approaches to Computational Barriers (CiE'06), volume 3988 of LNCS, pages 1–10. Springer-Verlag, 2006.
17. Erika Ábrahám, Frank S. de Boer, Willem-Paul de Roever, and Martin Steffen. A compositional operational semantics for JavaMT . In *Verification: Theory and Practice, Celebrating Zohar Manna's 64th Birthday*, volume 2772 of LNCS, pages 290–303. Springer-Verlag, 2004.
18. Erika Ábrahám-Mumm, Frank S. de Boer, Willem-Paul de Roever, and Martin Steffen. A tool-supported proof system for multithreaded Java. In *Proc. of the 1st Int. Symp. on Formal Methods for Components and Objects (FMCO'02)*, volume 2852 of LNCS, pages 1–32. Springer-Verlag, 2003.

Peer-reviewed journal publications and book chapters

1. Jasper Nalbach, Erika Ábrahám, Philippe Specht, Christopher W. Brown, James H. Davenport, and Matthew England. Levelwise construction of a single cylindrical algebraic cell. *Journal of Symbolic Computation*, 123:102288, 2024.
2. Stefan Schupp, Ábrahám, Md Tawhid Bin Waez, Thomas Rambow, and Zeng Qiu. On the applicability of hybrid systems safety verification tools from the automotive perspective. *International Journal on Software Tools for Technology Transfer*, 26(1):49–78, 2024.
3. Stefan Schupp, Erika Ábrahám, and Tristan Ebert. Recent developments in theory and tool support for hybrid systems verification with HyPro. *Information and Computation*, 289(Part):104945, 2022.
4. Oyendrila Dobe, Erika Ábrahám, Ezio Bartocci, and Borzoo Bonakdarpour. Model checking hyperproperties for Markov decision processes. *Information and Computation*, 289(Part):104978, 2022.
5. Isabela Drămnesc, Erika Ábrahám, Tudor Jebelean, Gábor Kusper, and Sorin Stratulat. Automated reasoning in the class. *Computeralgebra Rundbrief*, 71:21–27, 2022.
6. Erika Ábrahám, James H. Davenport, Matthew England, and Gereon Kremer. Deciding the consistency of non-linear real arithmetic constraints with a conflict driven search using

cylindrical algebraic coverings. *Journal of Logical and Algebraic Methods in Programming*, 119:100633, 2021.
7. Gereon Kremer and Erika Ábrahám. Fully incremental cylindrical algebraic decomposition. *Journal of Symbolic Computation*, 100:11–37, 2020.
8. Stefan Schupp, Justin Winkens, and Erika Ábrahám. Context-dependent reachability analysis for hybrid systems. In *Reuse in Intelligent Systems*, pagss 161–180. CRC Press, 2020.
9. Francesco Leofante, Erika Ábrahám, Tim Niemueller, Gerhard Lakemeyer, and Armando Tacchella. Integrated synthesis and execution of optimal plans for multi-robot systems in logistics. Information *Systems Frontiers*, 21(1):87–107, 2019.
10. Gereon Kremer and Erika Ábrahám. Modular strategic SMT solving with SMT-RAT. *Acta Universitatis Sapientiae, Informatica*, 10(1):5–25, 2018.
11. Erika Ábrahám, John Abbott, Bernd Becker, Anna M. Bigatti, Martin Brain, Bruno Buchberger, Alessandro Cimatti, James H. Davenport, Matthew England, Pascal Fontaine, Stephen Forrest, Alberto Griggio, Daniel Kroening, Werner M. Seiler, and Thomas Sturm. Satisfiability checking and symbolic computation. *ACM Communications in Computer Algebra*, 50(4):145–147, 2016.
12. Erika Ábrahám, Thi Mai Thuong Tran, and Martin Steffen. Observable interface behavior and inheritance. *Mathematical Structures in Computer Science*, 26(3):561–605, 2016.
13. Johanna Nellen, Kai Driessen, Martin R. Neuhäußer, Erika Ábrahám, and Benedikt Wolters. Two CEGAR-based approaches for the safety verification of PLC-controlled plants. *Information Systems Frontiers*, 18(5):927–952, 2016.
14. Mohamed Amin Ben Sassi, Sriram Sankaranarayanan, Xin Chen, and Erika Ábrahám. Linear relaxations of polynomial positivity for polynomial Lyapunov function synthesis. *IMA Journal of Mathematical Control and Information*, 33(3):723–756, 2016.
15. Ralf Wimmer, Nils Jansen, Erika Ábrahám, and Joost-Pieter Katoen. High-level counterexamples for probabilistic automata. *Logical Methods in Computer Science*, 11(1:15):1–23, 2015.
16. Daniela Lepri, Erika Ábrahám, and Peter Csaba Ölveczky. Sound and complete timed CTL model checking of timed Kripke structures and real-time rewrite theories. *Science of Computer Programming*, 99:128–192, 2015.
17. Muhammad Fadlisyah, Peter Csaba Ölveczky, and Erika Ábrahám. Formal modeling and analysis of interacting hybrid systems in HI-Maude: What happened at the 2010 Sauna World Championships? *Science of Computer Programming*, 99:95–127, 2015.
18. Nils Jansen, Ralf Wimmer, Erika Ábrahám, Barna Zajzon, Joost-Pieter Katoen, Bernd Becker, and Johann Schuster. Symbolic counterexample generation for large discrete-time Markov chains. *Science of Computer Programming*, 91(A):90–114, 2014.
19. Ralf Wimmer, Nils Jansen, Erika Ábrahám, Joost-Pieter Katoen, and Bernd Becker. Minimal counterexamples for linear-time probabilistic verification. *Theoretical Computer Science*, 549:61–100, 2014.
20. Erika Ábrahám, Tobias Schubert, Bernd Becker, Martin Fränzle, and Christian Herde. Parallel SAT solving in bounded model checking. *Journal of Logic and Computation*, 21(1):5–21, 2011.
21. Markus Geimer, Felix Wolf, Brian J. N. Wylie, Erika Ábrahám, Daniel Becker, and Bernd Mohr. The Scalasca performance toolset architecture. *Concurrency and Computation: Practice and Experience*, 22(6):702–719, 2010.

22. Erika Ábrahám, Immo Grabe, Andreas Grüner, and Martin Steffen. Behavioural interface description of an object-oriented language with futures and promises. *Journal of Logic and Algebraic Programming*, 78(7):491–518, 2009.
23. Erika Ábrahám, Frank S. de Boer, Willem-Paul de Roever, and Martin Steffen. A deductive proof system for multithreaded Java with exceptions. *Fundamenta Informaticae,* 82(4):391–463, 2008.
24. Erika Ábrahám, Andreas Grüner, and Martin Steffen. Heap-abstraction for an object-oriented calculus with thread classes. *Software and Systems Modeling*, 7(2):177–208, 2008.
25. Erika Ábrahám, Andreas Grüner, and Martin Steffen. Abstract interface behavior of object-oriented languages with monitors. *Theory of Computing Systems*, 43(3):322–361, 2008.
26. Erika Ábrahám, Frank S. de Boer, Willem-Paul de Roever, and Martin Steffen. An assertion-based proof system for multithreaded Java. *Theoretical Computer Science*, 331(2-3):251–290, 2005.

Peer-reviewed conference publications

1. Jasper Nalbach and Erika Ábrahám. Subtropical satisfiability for SMT solving. In *Proc. of the 15th NASA Formal Methods Symp. (NFM'23)*, volume 13903 of LNCS, pages 430–446. Springer-Verlag, 2023.
2. Lina Gerlach, Oyendrila Dobe, Erika Ábrahám, Ezio Bartocci, and Borzoo Bonakdarpour. Introducing asynchronicity to probabilistic hyperproperties. In *Proc. of the 20th Int. Conf. on Quantitative Evaluation of Systems (QEST'23),* volume 14287 of LNCS, pages 47–64. Springer-Verlag, 2023.
3. Lisa Willemsen, Anne Remke, and Erika Ábrahám. Comparing two approaches to include stochasticity in hybrid automata. In *Proc. of the 20th Int. Conf. on Quantitative Evaluation of Systems (QEST'23)*, volume 14287 of LNCS, pages 238–254. Springer-Verlag, 2023.
4. Joanna Delicaris, Stefan Schupp, Erika Ábrahám, and Anne Remke. Maximizing reachability probabilities in rectangular automata with random clocks. In *Proc. of the 17th Int. Symp. on Theoretical Aspects of Software Engineering (TASE'23)*, volume 13931 of LNCS, pages 164–182. Springer-Verlag, 2023.
5. Jasper Nalbach, Valentin Promies, Erika Ábrahám, and Paul Kobialka. FMplex: A novel method for solving linear real arithmetic problems. In *Proc. of the 14th Int. Symp. on Games, Automata, Logics, and Formal Verification (GandALF'23),* volume 390 of Electronic Proceedings in Theoretical Computer Science, pages 16–32, 2023.
6. Eshita Zaman, Gianfranco Ciardo, Erika Ábrahám, and Borzoo Bonakdarpour. HyperPCTL model checking by probabilistic decomposition. In *Proc. of the 17th Int. Conf. on Integrated Formal Methods (iFM'22*), volume 13274 of LNCS, pages 209–226. Springer-Verlag, 2022.
7. Isabela Drămnesc, Erika Ábrahám, Tudor Jebelean, Gábor Kusper, and Sorin Stratulat. *Experiments with automated reasoning in the class. In Proc. of the 15th Int. Conf. on Intelligent Computer Mathematics (CICM'22),* volume 13467 of LNCS, pages 287–304. Springer-Verlag, 2022.
8. Oyendrila Dobe, Lukas Wilke, Erika Ábrahám, Ezio Bartocci, and Borzoo Bonakdarpour. Probabilistic hyperproperties with rewards. In *Proc. of the 14th NASA Formal Methods Symp. (NFM'22),* volume 13260 of LNCS, pages 656–673. Springer-Verlag, 2022.
9. Rebecca Haehn, Erika Ábrahám, and Niklas Kotowski. Acceleration techniques for symbolic simulation of railway timetables. In Simon Collart Dutilleul, Anne E. Haxthausen, and Thierry

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Invited workshop contributions

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