Mid-Tenure Review

Niki Vazou

September 2, 2021

• **LIST OF PUBLICATIONS** Below I first enumerate my five most significant publications and then list the rest.

1. **N. Vazou**, E. Seidel, R. Jhala, D. Vytiniotis, and S. Peyton-Jones. Refinement Types for Haskell. ICFP, 2014. *216 citations*

   This paper introduces Liquid Haskell, a refinement type checker for Haskell programs and uses Liquid Haskell to verify 10K lines of real world Haskell code.

   I was the main contributor on this work, concretely, I developed all the metatheory section and conducted large portions of the implementation and the experiments.

2. **N. Vazou**, A. Tondwalkar, V. Choudhury, R. Newton, P. Wadler, and R. Jhala. Refinement Reflection: Complete Verification with SMT. POPL, 2018. *44 citations*

   This paper presents how decidable SMT-based verification can be used to allow theorem proving of arbitrary (undecidable) properties via refinement types.

   I was the main contributor on this work, concretely, I came up with the novel idea presented in the paper and developed large portions of the metatheory and evaluation.

3. J. Parker, **N. Vazou**, and M. Hicks. Information Flow Security for Multi-Tier Web Applications. POPL, 2019. *25 citations*

   This paper presents a framework for enforcing label-based, information flow policies in database-using web applications with a mechanized proof of non-interference.

   This work is without co-authorship of my PhD supervisor. I closely supervised the first author (who was a research programmer during this work) and did the metatheory of the system and most part of the paper writing.

4. M. Handley, **N. Vazou**, and G. Hutton. Liquidate your assets: Reasoning about resource usage in Liquid Haskell. POPL, 2020. *16 citations*

   This paper shows how refinement types can reason automatically about resources (e.g., time complexity and memory allocation).

   This work is without co-authorship of my PhD supervisor. I closely supervised the first author (who was a PhD student during this work) and I conducted the metatheory of the system, the major portion of the experimental comparison with relevant systems, and most part of the paper writing.

5. M. Kazerounian, S. N. Guria, **N. Vazou**, J. Foster, and D. Van Horn. Type-Level Computations for Ruby Libraries. PLDI, 2019. *7 citations*

   This paper presents an expressive type system for Ruby with type-level computations used to type check database queries in commonly used Ruby libraries.

   This work is without co-authorship of my PhD supervisor. I closely supervised the first author (who was a PhD student during this work) for the development of the system presented in this paper and the metatheory.

- N. Lehmann, R. Kunkel, J. Brown, J. Yang, **N. Vazou**, N. Polikarpova, D. Stefan, and R. Jhala STORM: Refinement Types for Secure Web Applications. USENIX, 2021.

- R. Jhala, and **N. Vazou**. Refinement Types: A Tutorial. Journal Foundations and Trends in Programming Language, 2021.
- Y. Liu, J. Parker, P. Redmond, L. Kuper, M. Hicks, and **N. Vazou**. Verifying replicated data types with typeclass refinements in Liquid Haskell. OOPSLA, 2020.
- **N. Vazou**, E. Tanter, and D. Van Horn. Gradual Liquid Type Inference. OOPSLA, 2018.
- **N. Vazou**, J. Breitner, R. Kunkel, D. Van Horn, and G. Hutton. Theorem proving for all: Equational reasoning in Liquid Haskell (functional pearl) Haskell, 2018.
- **N. Vazou**, J. Breitner, R. Kunkel, D. Van Horn, and G. Hutton. Theorem proving for all: Equational reasoning in Liquid Haskell (functional pearl) Haskell, 2018.
- M. Kazerounian, **N. Vazou**, A. Bourgerie, J. S. Foster, and E. Torlak. Refinement Types for Ruby. VMCAI, 2018.
- **N. Vazou**, L. Lampropoulos, and J. Polakow. A tale of two provers: verifying monoidal string matching in Liquid Haskell and Coq. Haskell, 2017.
- **N. Vazou** and D. Leijen. From Monads to Effects and Back. PADL, 2016.
- E. Seidel, **N. Vazou**, and R. Jhala. Type Targeted Testing. ESOP, 2015.
- **N. Vazou**, A. Bakst, and R. Jhala. Bounded Refinement Types. ICFP, 2015.
- **N. Vazou**, E. Seidel, and R. Jhala. Liquid Haskell: Experience with Refinement Types in the Real World. Haskell, 2014.
- **N. Vazou**, P. Rondon, and R. Jhala. Abstract Refinement Types. ESOP, 2013.
- **N. Vazou**, M. Papakyriakou, and N. Papaspyrou. Memory safety and race freedom in concurrent programming languages with linear capabilities. FedCSIS, 2011.

• **PROTOTYPES AND TOOLS DEVELOPED** Liquid Haskell that I maintain and extend with practical and novel experimental features during my research.

• **LIST OF GRANT SUPPORT**

2021	Advanced in the interview process of ERC Starting Grant.
2021 - 2023	Juan de la Cierva Incorporación Grant, by Spanish Ministry of Science and Innovation.
2020 - 2024	Atracción de Talento Fellowship, by Madrid Regional Government.

• **SELF-EVALUATION AND THREE YEAR VISION OF RESEARCH** My research is on refinement type systems and concretely my goal is to make SMT-based, decidable, semi-automated verification an integral part of legacy programming languages and usable by mainstream programmers. I have developed Liquid Haskell, a refinement type checker for Haskell programs that is adopted by the industrial, educational, and research Haskell community (with 18K hackage downloads, many tutorials in industrial venues, projects and courseworks by students and various security applications). I have 8 papers on CORE A (flagship) conferences (2 ICFP, 2 POPL, 1 PLDI, 1 OSDI, and 2 OOPSLA). My h-index is 10 and I have 635 citations.

In the next three years, I plan to work on three directions:

1. **Soundness of Refinement Types** I have already started the encoding of soundness of refinement types in refinement types themselves (i.e., Liquid Haskell). Even though this formalization is smoothly progressing it is time consuming and it's details are still under development. Given the current progress we expect to have results submitted to ICFP'22.
2. **Relational Refinement Types** We have started, in collaboration with Gilles Barthe, the development of a practical relational refinement type system. Our system aims to combine the sophisticated and automated verification technology of refinement types with the advantage of relational types to reason about two executions of the same program and thus being able to encode safety properties, such as non interference. We are working on the development on the verification of a machine learning algorithm as our case study and we expect to submit our results to PLDI'22.

3. **Refinement Types for Rust** Finally, we investigate on how refinement types can be used for other programming languages, such as Rust, that recently gained popularity, since it combines memory safety (without a garbage collector) with efficient runtimes. In this direction we have started the development of a refinement type checker for Rust programs with ultimate goal the verification of real-world cryptographic protocols. This is an ambitious novel project, but we expect to have early results submitted for publication at OOPSLA'22.

• STUDENT SUPERVISION

2019-present	- PhD candidate Lisa Vasilenko on "relational refinement types". - Master student Mustafa Hafidi on "tactics for Liquid Haskell'. - Undergrad student David Munuera on "Haskell to CIAO". - Research intern Adam Geller on "refinement types for Rust'. - Research intern Zack Grannan on "rewriting for Liquid Haskell'. - Research intern Stefan Malewski on "gradual refinement types". IMDEA Software Institute, Madrid, Spain. - Undergrad student David Munuera on "Linear Types for Cost Analysis". National Technical University of Athens, Athens, Greece.
2017-2018	- PhD candidate James Parker on "verification of secure web applications", co-supervised with Michael Hicks and published on POPL'19 and OOPSLA'20. - PhD candidate Milod Kazerounian on "refinement types for Ruby", co-supervised with Jeff Foster and published on VMCAI'18 and PLDI'19. Computer Science Department, University of Maryland, College Park, USA.
2018	- Diploma student George Petrou on "verification with Liquid Haskell", co-supervised with Nikolaos Papaspyrou. National Technical University of Athens, Athens, Greece.

• SERVICE: ORGANISATION OF SCIENTIFIC MEETINGS

2021, 2022	Co-Chair, Artifact Evaluation, PLDI.
2020	Virtualization Committee, POPL.
2020	Co-Chair, Student Research Competition, POPL.
2019	Chair, Student Research Competition, POPL.
2019	Chair, Haskell Implementors' Workshop.
2019	Co-Chair, Programming Languages and Analysis for Security.
2018	Co-Organizer, Programming Languages Mentoring Workshop, ICFP.
2018	Co-Chair, Workshop on Type-Driven Development.

• SERVICE: REVIEWING ACTIVITIES

OOPSLA'22, WITS'22, POPL'21, VMCAI'21, CAV'20, FCS'20, POPL'19, ESOP'18, ICFP'18, PEPM'21, PLS'21, TFP'20, Haskell'18, ML-Family Workshop'17, HOPE'17, PADL'17, Scala'17, Haskell'16, HiW'16, TFP'16, PADL'16, Scala'16, AEC@POPL'16, AEC@PLDI'16.

• SERVICE: MEMBERSHIPS OF SCIENTIFIC SOCIETIES

2021 - present	Board Member of Haskell Foundation.
2019 - present	Visitor of IFIP Working Group 2.1 on Algorithmic Languages and Calculi.
2019 - present	Visitor of IFIP Working Group 2.8 on Functional Programming.
2017 - present	Member of The ACM SIGPLAN Haskell Symposium Steering Committee.
2016 - 2020	Member of Haskell.org Committee.
2015 - 2016	Event Coordinator at Graduate Women in Computing, UCSD.

• **COLLABORATIONS WITH ACADEMIA AND INDUSTRY**

INTERNAL *Gilles Barthe* on Refinement Types for Rust for Cryptographic Protocols.
Marco Guarnieri on Qualified Information Flow.

INDUSTRY *Andres Löh* on Improving the usability of Liquid Haskell,
Well-Typed LLP, Regensburg, Germany.
Dimitrios Vytiniotis on Verification of Haskell,
DeepMind, London, UK.

ACADEMIC *Simon Peyton Jones* on Verification of Haskell
Microsoft Research, Cambridge, UK.
Graham Hutton on Verification of Haskell
Computer Science, University of Nottingham, UK.
Philip Wadler on Logics for Functional Verification
School of Informatics, University of Glasgow, UK.
Michael Hicks and *David Van Horn* on Applications of Verification to Security,
Computer Science Department, University of Maryland, College Park, USA.
Éric Tanter on Gradual Types
Computer Science Department, University of Chile, Santigo, Chile.
Michael Greenberg on Logics for Refinement Types,
Computer Science, Stevens Institute of Technology, New Jersey, USA.
Jeffrey S. Foster on Refinement Types for Ruby
Computer Science, Tufts University, Massachusetts, USA.
Lindsey Kuper on Verification of Distributed Protocols,
Computer Science and Engineering, University of California, Santa Cruz, USA.
Ranjit Jhala on Refinement Types,
Computer Science and Engineering, University of California, San Diego, USA.

Curriculum vitae

• PERSONAL INFORMATION

Family name, First name: Vazou, Niki
Researcher identifiers: orcid: 0000-0003-0732-5476, publons: 3145359, google scholar: ARcLTokAAAAJ
Date of birth: 20 July, 1987
Nationality: Greek
URL for web site: `https://nikivazou.github.io/`

• EDUCATION

2011-2017	PhD Computer Science and Engineering, University of California, San Diego, USA. Supervisor: Ranjit Jhala; Thesis title: "Liquid Haskell: Haskell as a Theorem Prover".
2005-2010	Diploma National Technical University of Athens, Athens, Greece.

• CURRENT POSITION

2018-present	Research Assistant Professor IMDEA Software Institute, Madrid, Spain.

• PREVIOUS POSITIONS

2017-2018	Postdoctoral Fellow Computer Science Department, University of Maryland, College Park, USA.
Summer 2016	Internship with Jeff Polakow Awake Networks, Mountain View, USA.
Summer 2014	Internship with Daan Leijen Microsoft Research, Redmond, USA.
Fall 2013	Internship with Dimitrios Vytiniotis Microsoft Research, Cambridge, UK.

• SUPERVISION OF GRADUATE STUDENTS AND POSTDOCTORAL FELLOWS

2019-present	- PhD candidate Christian Poveda on "refinement types for Rust", co-supervised with Gilles Barthe. - PhD candidate Lisa Vasilenko on "relational refinement types". - Master student Mustafa Hafidi on "tactics for Liquid Haskell'. - Undergrad student David Munuera on "Haskell to CIAO". - Research intern Zack Grannan on "rewriting for Liquid Haskell'. - Research intern Stefan Malewski on "gradual refinement types". IMDEA Software Institute, Madrid, Spain.
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2018	- Diploma student George Petrou on "verification with Liquid Haskell", co-supervised with Nikolaos Papaspyrou. National Technical University of Athens, Athens, Greece.

• TEACHING ACTIVITIES

Fall 2019	2 months/20 hours seminar on Advanced Functional Programming, Computer Science Department, Universidad Politécnica de Madrid, Madrid, Spain.
Winter 2018	Lecturer at Advanced Functional Programming (CMSC498V), Computer Science Department, University of Maryland, College Park, USA.
Fall 2017	Co-Lecturer at Introduction to Programming (CMSC330), Computer Science Department, University of Maryland, College Park, USA.
Summer 2015	1 week/40 hours course on Functional Programming, Clubes De Ciencia, Guanajuato, Mexico.

• ORGANISATION OF SCIENTIFIC MEETINGS

2021	Co-Chair, Artifact Evaluation, PLDI.
2020	Virtualization Committee, POPL.
2020	Co-Chair, Student Research Competition, POPL.
2019	Chair, Student Research Competition, POPL.
2019	Chair, Haskell Implementors' Workshop.
2019	Co-Chair, Programming Languages and Analysis for Security.
2018	Co-Organizer, Programming Languages Mentoring Workshop, ICFP.
2018	Co-Chair, Workshop on Type-Driven Development.

• REVIEWING ACTIVITIES

POPL'21, VMCAI'21, CAV'20, FCS'20, POPL'19, ESOP'18, ICFP'18, PEPM'21, PLS'21, TFP'20, Haskell'18, ML-Family Workshop'17, HOPE'17, PADL'17, Scala'17, Haskell'16, HiW'16, TFP'16, PADL'16, Scala'16, AEC@POPL'16, AEC@PLDI'16.

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2019 - present	Visitor of IFIP Working Group 2.8 on Functional Programming.
2017 - present	Member of The ACM SIGPLAN Haskell Symposium Steering Committee.
2016 - 2020	Member of Haskell.org Committee.
2015 - 2016	Event Coordinator at Graduate Women in Computing, UCSD.

• MAJOR COLLABORATIONS

Gilles Barthe on Refinement Types for Rust for Cryptographic Protocols,
Max Planck Institute for Security and Privacy, Bochum, Germany.
Michael Hicks and *David Van Horn* on Applications of Verification to Security,
Computer Science Department, University of Maryland, College Park, USA.
Michael Greenberg on Logics for Refinement Types,
Computer Science, Pomona College, Claremont, USA.
Ranjit Jhala on Refinement Types,
Computer Science and Engineering, University of California, San Diego, USA.

• FELLOWSHIPS AND AWARDS

2021 - 2023	Juan de la Cierva Incorporación Grant, by Spanish Ministry of Science and Innovation.
2020 - 2024	Atracción de Talento Fellowship, by Madrid Regional Government.
2018	Best paper award at ACM SIGPLAN Conference OOPSLA.
2017 - 2018	Victor Balisi Postdoctoral Fellowship, University of Maryland, College Park, USA.
2015	Graduate Award for Research, University of California, San Diego, USA.
2014 - 2016	Microsoft Research Graduate Research Fellowship.