Peter O'Hearn, Brief CV

Professional History and Academic Qualifications

- Facebook UK Ltd, since 9/2013. I have variously held Engineer, Manager, Director and (currently) Research Scientist positions
- University College London. Professor of Computer Science, since 3/2012 (part-time since moving to Facebook with acquisition of Monoidics)
- Co-founder and Director of Monoidics Ltd, 2009-2013
- Queen Mary, University of London. Reader from 1996-1999, Professor from 1999-2012
- Syracuse University. Assistant Professor, 8/90 to 12/95
- PhD (1991), MSc (1987) in Computer Science, Queen's University, Kingston, Ontario, Canada
- BSc (1985) in Computer Science, Dalhousie University, Halifax, Nova Scotia, Canada

Fellowships, Awards, etc

Doctor of Laws Honoris Causa (Honorary Doctorate), Dalhousie University, 2018

Fellow of the Royal Society, elected 2018

Fellow of the Royal Academy of Engineering, elected 2016

Gödel Prize, 2016. For the invention of Concurrent Separation Logic.

CAV Award, 2016. For the development of Separation Logic and for demonstrating its applicability in the automatic verification of programs that mutate data structures.

Royal Academy of Engineering/Microsoft Research Chair, 2012 (5-year research professorship, interrupted by move to Facebook in 2013)

Most Influential POPL Paper Award, 2011. For POPL'01 paper "BI as an Assertion Language for Mutable Data Structures"

Royal Society Wolfson Research Merit Award, 2007

Main Contributions

- Separation Logic (with JC Reynolds and others, papers [1,9,12,13] in the selected publications below), attacking 30-year problem of tractable reasoning about data structures in computer memory.

  As part of the work on Separation Logic I discovered a theory of *local reasoning*, where specifications and proofs mention only the resources (memory, files, etc) accessed by program components, leading to scalability of automated reasoning applied to large codebases.
- Concurrent Separation Logic [5], which advanced a new approach to modular reasoning about shared-memory concurrent programs.
- Bunched Logic (with DJ Pym, [14]), a novel logic of resources. Separation Logic builds on Bunched Logic.
- Relational Semantics of Local State (with RD Tennent [15]), combining functor categories and relations to describe mathematical principles underlying hidden state in programs
- Separation Logic-based automated verification and analysis (with Berdine, Calcagno, Distefano, Yang and others), achieving the leading research results on automatic analysis of mutable data structures in real-world systems code, represented in the academic tool projects Smallfoot [6] Space Invader [6], Abductor[4]

- Co-founded Monoidics Ltd in 2009, which marketed a software verification tool, INFER, that automated my Local Reasoning method. Monoidics was acquired by Facebook in 2013 [B], and as part of the deal I took a position at Facebook.

- Led the Infer static analysis team inside Facebook, 2013-2017, producing some of most significant industrial impact in the history of formal methods. Over 100,000 issues reported by Infer have been fixed by Facebook developers before reaching production, affecting the the main Facebook app, Instagram, Messenger, and WhatsApp, among the most-used mobile applications in the world (involving billions of people per day). Infer was open-sourced in 2015 [C,D], and has been used by other companies including Amazon, Spotify, Uber, JD.com, Sky and Marks and Spencer, as well as Facebook [E].

  As part of work on Infer (co-)developed and promoted the Continuous Reasoning model [2], where analysis or verification is done incrementally on code modifications. This model has led to further industrial developments at Amazon and Galois.

- RacerD concurrency analysis [2,3,A]. Moved from management to a research role at Facebook in 2017 to concentrate on technical work, starting with static concurrency analysis (a longstanding open problem). As far as I am aware, RacerD has the most reported impact from a static analysis for concurrency to date: it has seen >3000 data race issues fixed by Facebook developers and was instrumental in the conversion of Facebook's Android app from a single-threaded to a multi-threaded model.

Selected Publications

1. Separation Logic. P O'Hearn: *Communications of the ACM, February 2019, vol. 62, no. 2*
2. RacerD: Compositional Static Race Detection. S Blackshear, N Gorrogiannis, P O'Hearn, I Sergey: *OOPSLA 2018*
3. Experience Developing and Deploying Concurrency Analysis at Facebook. P O'Hearn. *SAS 2018*
4. Continuous Reasoning: Scaling the Impact of Formal Methods. P O'Hearn : *LICS 2018*
5. Moving Fast with Software Verification. C Calcagno, D Distefano, J Dubreil, D Gabi, P Hooimeijer, M Luca, PW O'Hearn, I Papakonstantinou, J Purbrick, D Rodriguez: *NASA Formal Methods Symposium, 2015.*
6. Compositional Shape Analysis by means of Bi-Abduction. C Calcagno, D Distefano, PW O'Hearn, and H Yang. *Journal of the ACM 58(6): 26 (2011)*, 73 pages. (Preliminary version appeared in POPL'09.)
7. Scalable Shape Analysis for Systems Code. H Yang, O Lee, J Berdine, C Calcagno, B Cook, D Distefano and P O'Hearn. *CAV 2008*
8. Resources, Concurrency and Local Reasoning. PW O'Hearn. *Theoretical Computer Science 375(1-3), pp271-307*, 2007. (Prelim version appeared in CONCUR'04)
9. Local Action and Abstract Separation Logic. C Calcagno, PW O'Hearn and H Yang. *LICS 2007*
10. A local shape analysis based on separation logic. D Distefano, P O'Hearn and H Yang. *TACAS 2006*
11. Smallfoot: Modular Automatic Assertion Checking with Separation Logic. J Berdine, C Calcagno and PW O'Hearn. In *FMCO 2006*.
12. Local Reasoning about Programs that Alter Data Structures. P O'Hearn, J Reynolds, and H Yang. *CSL 2001*

13. BI as an assertion language for mutable data structures. S Ishtiaq and PW O'Hearn. *POPL 2001*

14. The logic of bunched implications. PW O'Hearn and DJ Pym. *Bulletin of Symbolic Logic*, 5(2), June 1999, pp215-244.

15. Parametricity and Local Variables. PW O'Hearn and RD Tennent. *Journal of the Association for Computing Machinery, 42(3), 658-709*, May 1995. (Prelim verison in POPL'93.)

Selected Non-academic References on Impact and Significance of Facebook Infer

A. "Facebook Engineering Takes a Bite out of Concurrency with RacerD." Michelle Gienow, **TheNewStack, 19 October 2017**

B. "Facebook Acquires Assets Of UK Mobile Bug-Checking Software Developer Monoidics." Josh Constine, **Techcrunch, 18 July 2013**

C. "Open Sourcing Facebook Infer." Cristiano Calcagno, Dino Distefano and Peter O'Hearn. **code.facebook.com blog, 11 June 2015**

D. "Facebook's AI Tool for Squashing Bugs is now Open to All." Klint Finley, **Wired, 11 June 2015**

E. "Four Facebook Employees Win the Prestigious CAV Award." Bryan O'Sullivan. **research.fb.com blog, 5 Sept 2016** (Stating over 1000 bugs/month fixed)

F. *fbinfer.com*. Web page showing Infer's open-source users including Amazon, Spotify, Uber, Mozilla and JD.com.

Personal Information

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Contact Information

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