# Curriculum Vitae

## Ireneusz Ulidowski

## Personal information


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| Date of Birth: | 14.04.1959 |
| Nationality: | Polish and British |
| Office: | School of Computing and Mathematical Sciences, University of Leicester, Leicester, LE1 7RH, United Kingdom |
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### Education

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| 1974 - 78 | Liceum Stanislawa Staszica, Lublin, Polska | A-Levels: Mathematics, Geography, English: A, Polish: B. |
| 1978 - 81 | Szkoła Główna Handlowa, Warszawa, Polska | Economics and Organisation of Foreign Trade. 3 years completed out of 4.5 year degree. |
| 1984 - 87 | Queen Mary College, University of London | **BSc** in Mathematics and Computer Science. Degree: First Class Honours. |
| 1987 - 88 | Imperial College London | **MSc** in Foundations of Advanced Information Technology. |
| 1988 - 94 | Imperial College London | **PhD** in Concurrency Theory. |

### Employment

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| 1990 - 1992 | Department of Computing, Imperial College London. Position: Teaching Assistant. |
| 1992 - 1994 | School of Computing, University of North London. Position: Lecturer. |
| 1994 - 1997 | Research Institute for Mathematical Sciences (RIMS), Kyoto University, Japan. Position: Associate Professor. |
| 1997 - 1998 | School of Informatics and Multimedia Technology, University of North London. Position: Lecturer (Assistant Professor). |
| 1998 - 2006 | Department of Computer Science, University of Leicester. Position: Lecturer (Assistant Professor). |
| 2006 - present | Department of Computer Science, University of Leicester. Position: Associate Professor. |

I held visiting research positions at Nagoya University, Technical University of Eindhoven, and Kyoto University.

### Academic Highlights

- Chairman of COST Action IC1405 on Reversible Computation (http://www.revcomp.eu/).
- Co-proposer and host of Marie Skłodowska-Curie Action Fellowship of Claudio Antares Mezzina.
- A founding member of IFIP WG 1.8 on Concurrency Theory.
- Chair of Steering Committee of Reversible Computation conference (http://www.reversible-computation.org/). Member of Steering Committee of EXPRESS - Structural Operational Semantics workshop.
- An editor of the Electronic Proceedings in Theoretical Computer Science (http://www.eptcs.org/).

# Research

## Research Expertise

My main research interests are in **concurrency theory**, an area of computer science which concerns the modelling and reasoning about parallel and distributed systems, and in the modelling and semantics of **reversible computation**. In concurrency theory I worked mainly on process calculi and on **Structural Operational Semantics** (SOS) and its extensions with priority orderings. I developed formats of SOS rules and proved congruence results, devised procedures for automatic generation of sound and complete proof systems for general process calculi, and worked on the modelling of discrete time in process calculi.

My interest in reversible computation as an alternative paradigm of computation started over 15 years ago. During this period I worked on the models of reversible computation, reversible process calculi and reversible event structures, bisimulation equivalences and modal logic semantics for systems that compute both forwards and in reverse, and how reversibility bridges the gap between the interleaving and *true-concurrency* semantics of concurrency. I applied reversible process calculi in the modelling of bio-chemical reactions, fault recovery in long-running transactions, and the modelling of asynchronous Delay-Insensitive (DI) circuits. I developed a novel calculus for (reversible) chemical reactions inspired by the covalent bonding mechanism. I proposed techniques for reversing imperative parallel programs, such as C with threads, with applications in reversible debugging. I also carried out research on priority term rewriting. The main results are as follows:

- **Reversible computation**. Jointly with Phillips and Yuen, I developed the first method for reversing arbitrary process calculi [18,20] (See Publications below). This method was applied to produce CCS with Keys (CCSK): a reversible version of Milner's CCS. CCSK was extended with an execution control mechanism [27-28] which can be used to specify the pattern and direction of execution. Thus we showed that recovery from failure and compensations as well as bio-chemical reactions that depend on undoing of chemical bonds can be modelled naturally [27-28].

  The research on reversibility lead us to define a new hierarchy **bisimulation semantics** based on both the forward and reverse observations such as single events, steps, and pomsets [24,26]. We showed that some of these new equivalences coincide with previously proposed true-concurrency equivalences, and answered in negatives some open questions posed by Bednarczyk. In [24-27], we argued that, true-concurrency models and semantics can be achieved from the well known interleaving models and semantics by considering additionally reversibility. This can be captured by the equation true-concurrency = interleaving + reversibility.

  We also developed a powerful and elegant **modal logic** based on Hennessy Milner logic which introduced reverse modalities and new event identifiers in modalities [25,31], and showed that it characterises fully all major true-concurrency bisimulation equivalences (including those in [26]). This gave, for example, the first ever logic characterisation of weak history preserving bisimulation.

  In [28,30,32,42] Phillips, Yuen and I defined for the first time **reversible event structures** that allowed us to model not only typical causal order reversibility but also general reversibility that underpins many mechanisms in nature for achieving change and progress in biochemical systems. Then, in collaboration with Melgratti, Mezzina and Pinna, I developed reversible versions of Place Transition nets and occurrence nets [43,45,47].

  Jointly with Morrison I provided a formulation of Delay-Insensitive circuits in process calculi [29,33], thus clarifying the meaning of arbitration in the asynchronous setting. We gave several new universality results and defined novel **cellular automata** for realising DI circuits [34].

  Kuhn and I proposed a novel **reversible calculus for chemical reactions** inspired by the covalent bonding mechanism [35,37,40,51]. This is the first calculus where reversibility arises from local interactions alone. We have applied the calculus recently to model DNA mismatch repair mechanism [55].

  Jointly with Hoey and Yuen I proposed techniques for **reversing imperative parallel programs**, such as those in C with threads, with applications in **reversible debugging** [39,41,44,50,55]. We showed that our techniques are correct and reversing does not produce any garbage.

  Finally, I have developed an axiomatic approach for reversing concurrent calculi, programming languages or model of computation in collaboration with Lanese and Phillips [46]. It builds upon and extends the results in [18,21] using transition systems with independence.

- **Concurrency Theory and Structural Operational Semantics**. I developed the first formats of SOS rules with silent actions for several divergence sensitive versions of well known behavioural preorders: *testing preorder* [5,9], *refusal testing* and *refusal simulation* preorders [1,13], *eager bisimulation* and *branching bisimulation* preorders [7,14], and their *rooted* versions [10]. In collaboration with Phillips, I developed *Ordered* SOS (OSOS), an extension of Plotkin's SOS approach where rules are equipped with **priority orderings** [7,14,22]. This new feature specifies the order of application of rules when deriving transitions of process terms. This was generalised to the Ordered Tyft format in a joint work with Mousavi, Phillips and Reniers [19,22].

  Traditional process calculi are well suited for describing the functional behaviour of systems but they lack the ability to express the temporal behaviour. In collaboration with Yuen, I developed a general technique for adding **discrete time** to process calculi in the OSOS format [8,16].

  **Automatic generation of proof systems**. The De Simone format with silent actions consists of simple CCS-like SOS rules and special rules that describe the propagation of silent actions in processes. For process calculi that are operationally definable by such De Simone rules, I developed algorithms for generating sound and complete axiom systems for testing preorder [5,9] and refusal simulation preorder [3,4].

  **Term rewriting with priorities**. I proposed a procedure for generating a Priority Rewrite System (PRS) for an arbitrary process calculus in the OSOS format [15,23]. I showed that rewriting of process terms is sound for bisimulation and head normalising.

# Publications

### Selected Papers in Refereed Conferences and Journals


1. Irek Ulidowski. Equivalences on Observable Processes. In the *Proceedings of the 7th Annual IEEE Symposium on Logic in Computer Science LICS 1992*, Santa Cruz, California, 1992. IEEE Computer Society Press, 1992.

2. Irek Ulidowski. Congruences for $\tau$-respecting Formats of Rules. In G. Burn, S. Gay and M. Ryan, editors, *Theory and Formal Methods 1993*. Springer-Verlag, 1993.

3. Irek Ulidowski, A Complete Proof System for an ISOS Process Language. In *Proceedings of Applied Mathematics Workshop*, Ryukoku University, Otsu, Japan, 1994.

4. Irek Ulidowski. Axiomatisations of Weak Equivalences for De Simone Languages. In I. Lee and S.A. Smolka, editors, *Proceedings of CONCUR'95*, Philadelphia, 1995. Springer, LNCS 962.

5. Irek Ulidowski. Finite Axiom Systems for Testing Preorder and De Simone Process Languages. In M. Wirsing and M. Nivat, editors, *Proceedings of the 5th International Conference on Algebraic Methodology and Software Technology AMAST'96*, München, 1996. Springer, LNCS 1101.

6. Iain Phillips and Irek Ulidowski. Ordered SOS Rules and Weak Bisimulation. In A. Adalat, S. Jourdan and G. McCusker, editors, *Advances in Theory and Formal Methods of Computing*. Imperial College Press, 1996.

7. Irek Ulidowski and Iain Phillips. Formats of Ordered SOS Rules with Silent Actions. In M. Bidoit and M. Dauchet, editors, *Proceedings of the 7th International on Theory and Practice of Software Development TAPSOFT'97*, Lille, 1997. Springer, LNCS 1214.

8. Irek Ulidowski and Shoji Yuen. Extending Process Languages with Time. In M. Johnson, editor, *Proceedings of of AMAST'97*, Sydney, 1997. Springer, LNCS 1349.

9. Irek Ulidowski. Finite Axiom Systems for Testing Preorder and De Simone Process Languages. ***Theoretical Computer Science*** 239(1), pp 97-139, 2000.

10. Irek Ulidowski and Shoji Yuen. Process Languages for Rooted Eager Bisimulation. In C. Palamidessi, editor, *Proceedings of the 11th International Conference of Concurrency Theory CONCUR 2000*, University Park, Pennsylvania, 2000. Springer, LNCS 1877.

11. Irek Ulidowski and Shoji Yuen. Timed Properties for Process Languages with Time. In N. Callaos, Fernando G. Tinetti, J.M. Champarnaud and Jong Kun Lee, editors, *Proceedings of SCI 2001*, Orlando, Florida. IIIS, 2001.

12. I. Ulidowski and S. Yuen. Timed Properties for Processes Time. In *Proceedings of RIEC International Symposium on Rewriting in Proof and Computation*, Sendai, Japan, 2001.

13. Irek Ulidowski. Refusal simulation and interactive games. In H. Kirchner and C. Ringeissen, editors, *Proceedings of AMAST 2002*, Reunion Island, France, 2002. Springer, LNCS 2422.

14. Irek Ulidowski and Iain Phillips. Ordered SOS Rules and Process Languages for Branching and Eager Bisimulations. ***Information and Computation***, 178(1), pp 180–213, 2002.

15. Irek Ulidowski. Priority Rewrite Systems for OSOS Process Languages. In R. Amadio and D. Lugiez, editors, *Proceedings of CONCUR 2003*, Marseilles, 2003. Springer, LNCS 2761.

16. Irek Ulidowski and Shoji Yuen. Process Languages with Discrete Relative Time based on the Ordered SOS Format and Rooted Eager Bisimulation. ***The Journal of Logic and Algebraic Programming***, 60–61, pp 401-461, 2004.

17. Iain Phillips and Irek Ulidowski. Operational Semantics of Reversibility in Process Algebra. In L. Aceto and A.D. Gordon, editors, *Essays on Algebraic Process Calculi*, Bertinoro, Italy, 2005. ENTCS, Volume 162, September 2006.

18. Iain Phillips and Irek Ulidowski. Reversing Algebraic Process Calculi. In L. Aceto and A. Ingólfsdóttir, editors, *Proceedings of the 9th International Conference on Foundations of Software Science and Computation Structures FOSSACS 2006*, Vienna, 2006. Springer, LNCS 3921.

19. M. Mousavi , I. Phillips, M.A. Reniers and I. Ulidowski. The Meaning of Ordered SOS. In S. Arun-Kumar and Naveen Garg, editors, *Proceedings of the 26th International Conference on Foundations of Software Technology and Theoretical Computer Science FSTTCS 2006*, Kolkata, India, 2006. Springer, LNCS 4337.

20. Iain Phillips and Irek Ulidowski. Reversing Algebraic Process Calculi. ***The Journal of Logic and Algebraic Programming***, 73, pp 70-96, 2007.

21. Iain Phillips and Irek Ulidowski. Reversibility and Models for Concurrency. *Proceedings of the 4th Workshop on Structural Operational Semantics (SOS 2007)*, ENTCS 192, pp 93-108, 2007.

22. Mohammad Reza Mousavi, Iain Phillips, Michel A. Reniers, Irek Ulidowski. Semantics and Expressiveness of Ordered SOS. ***Information and Computation***, 207(2), pp 85-119, 2009.

23. Irek Ulidowski and Shoji Yuen. Generating priority rewrite systems for OSOS process languages. ***Information and Computation*** 207(2), pp 120-145, 2009.

24. Iain Phillips and Irek Ulidowski. Reverse Bisimulations on Stable Configuration Structures. *Proceedings of SOS 2009*. EPTCS, volume 18, pp 62-76, 2010.

25. Iain Phillips and Irek Ulidowski. A Logic with Reverse Modalities for Hierarchy-preserving Bisimulations. *Proceedings of EXPRESS 2011*. EPTCS, volume 64, pp 104-118, 2011.

26. Iain Phillips and Irek Ulidowski. A Hierarchy of Reverse Bisimulations on Stable Configuration Structures. ***Mathematical Structures in Computer Science***, 22, pp 333-372, 2012.

27. Iain Phillips, Irek Ulidowski and Shoji Yuen. A Reversible Process Calculus and the Modelling of the ERK Signalling Pathway. *Proceedings of Reversible Computation 2012*, Copenhagen, 2013. Springer, LNCS 7581, pp 218-233.

28. Iain Phillips, Irek Ulidowski and Shoji Yuen. Modelling of bonding with processes and events. *Proceedings of Reversible Computation 2013*, Victoria, Canada, 2013. Springer, LNCS 7948, pp 141-155.

29. Daniel Morrison and Irek Ulidowski. Reversible delay-insensitive distributed memory modules. *Proceedings of Reversible Computation 2013*, Victoria, Canada, 2013. Springer, LNCS 7948, pp 11-24.

30. Iain Phillips and Irek Ulidowski. Reversibility and asymmetric conflict in event structures. *Proceedings of CONCUR 2013*, Buenos Aires, 2013. Springer, LNCS 8052, pp 303-318.

31. Iain Phillips and Irek Ulidowski. Event Identifier Logic. ***Mathematical Structures in Computer Science***, 24, pp 1-51, 2014.

32. Irek Ulidowski, Iain Phillips, Shoji Yuen. Concurrency and reversibility. *Proceedings of Reversible Computation 2014*, Kyoto, Japan, 2014. Springer, LNCS 8507, pp 1-14.

33. Daniel Morrison and Irek Ulidowski. Arbitration and reversibility of parallel Delay-Insensitive modules. *Proceedings of Reversible Computation 2014*, Kyoto, Japan, 2014. Springer, LNCS 8507, pp 67-81.

34. Daniel Morrison and Irek Ulidowski. Direction-reversible Self-Timed Cellular Automata for Delay-Insensitive circuits. *Proceedings of ACRI 2014*, Krakow, Poland, 2014. Springer, LNCS 8751, pp 367–377.

35. Stefan Kuhn and Irek Ulidowski. Towards Modelling of Local Reversibility. *Proceedings of Reversible Computation 2015*, Grenoble, France, 2015. Springer, LNCS 9138, pp. 279-284.

36. Iain Phillips and Irek Ulidowski. Reversibility and asymmetric conflict in event structures. ***Journal of Logical and Algebraic Methods in Programming***. 2015.

37. Stefan Kuhn and Irek Ulidowski. A calculus for local reversibility. *Proceedings of Reversible Computation 2016*, Bologna, Italy, 2016. Springer LNCS 9720, pp. 20-35.

38. Daniel Morrison and Irek Ulidowski. Direction-reversible self-timed cellular automata for Delay-Insensitive circuits. ***Journal of Cellular Automata*** 12:101-120. 2016.

39. James Hoey, Irek Ulidowski and Shoji Yuen. Reversing Imperative Parallel Programs. *Proceedings Combined 24th International Workshop on Expressiveness in Concurrency and 14th Workshop on Structural Operational Semantics*, EXPRESS/SOS 2017. EPTCS, volume 255, 2017, pp. 51-66.

40. Stefan Kuhn and Irek Ulidowski. Local reversibility in a Calculus of Covalent Bonding. ***Journal of Science of Computer Programming***, 151:18-47. 2018.

41. James Hoey, Irek Ulidowski and Shoji Yuen. Reversing Imperative Programs with Blocks and Procedures. *Proceedings Combined 25th International Workshop on Expressiveness in Concurrency and 15th Workshop on Structural Operational Semantics*, EXPRESS/SOS 2018. EPTCS, volume 276, pp. 69-86. 2018.

42. Irek Ulidowski, Iain Phillips and Shoji Yuen. Reversing Event Structures. ***New Generation Computing***, 36(3), 281-306. 2018.

43. Hernán C. Melgratti, Claudio Antares Mezzina, Irek Ulidowski: Reversing P/T Nets. *Proceedings of COORDINATION 2019*. Springer LNCS 11533, pp. 19-36.

44. James Hoey, Irek Ulidowski: Reversible Imperative Parallel Programs and Debugging. *Proceedings of Reversible Computation 2019*. Springer LNCS 11497, pp. 108-127.

45. Hernán C. Melgratti, Claudio Antares Mezzina, Irek Ulidowski: Reversing Place Transition Nets. ***Logical Methods in Computer Science*** 16(4), 2020

46. Ivan Lanese, Iain C. C. Phillips, Irek Ulidowski: An Axiomatic Approach to Reversible Computation. *Proceedings of FoSSACS 2020*. Springer LNCS 12077, pp. 442-461.

47. Hernán C. Melgratti, Claudio Antares Mezzina, Iain Phillips, G. Michele Pinna, Irek Ulidowski: Reversible Occurrence Nets and Causal Reversible Prime Event Structures. *Proceedings of Reversible Computation 2020*. Springer LNCS 12227, pp. 35-53.

48. Bogdan Aman, Gabriel Ciobanu, Robert Glück, Robin Kaarsgaard, Jarkko Kari, Martin Kutrib, Ivan Lanese, Claudio Antares Mezzina, Lukasz Mikulski, Rajagopal Nagarajan, Iain C. C. Phillips, G. Michele Pinna, Luca Prigioniero, Irek Ulidowski, Germán Vidal: Foundations of Reversible Computation. Selected Results of the COST Action IC1405 2020: Springer LNCS 12070, pp. 1-40.

49. Claudio Antares Mezzina, Rudolf Schlatte, Robert Glück, Tue Haulund, James Hoey, Martin Holm Cservenka, Ivan Lanese, Torben Æ. Mogensen, Harun Siljak, Ulrik Pagh Schultz, Irek Ulidowski: Software and Reversible Systems: A Survey of Recent Activities. Selected Results of the COST Action IC1405 2020: Springer LNCS 12070, pp. 41-59.

50. James Hoey, Ivan Lanese, Naoki Nishida, Irek Ulidowski, Germán Vidal: A Case Study for Reversible Computing: Reversible Debugging of Concurrent Programs. Selected Results of the COST Action IC1405 2020: Springer LNCS 12070, pp. 108-127.

51. Stefan Kuhn, Bogdan Aman, Gabriel Ciobanu, Anna Philippou, Kyriaki Psara, Irek Ulidowski: Reversibility in Chemical Reactions. Selected Results of the COST Action IC1405 2020: Springer LNCS 12070, pp. 151-176.

52. Ivan Lanese, Ulrik Pagh Schultz, Irek Ulidowski: Reversible Execution for Robustness in Embodied AI and Industrial Robots. ***IT Professional*** 23(3): 12-17, 2021.

53. Stefan Kuhn, Irek Ulidowski: Modelling of DNA mismatch repair with a reversible process calculus. ***Theoetical Computer Science*** 925: 68-86, 2022.

54. James Hoey, Irek Ulidowski: Towards Causal-Consistent Reversibility of Imperative Concurrent Programs. *Proceedings of Reversible Computation 2022*. Springer LNCS 13354, pp. 213-223.

55. Ivan Lanese, Ulrik Pagh Schultz, Irek Ulidowski: Reversible Computing in Debugging of Erlang Programs. ***IT Professional*** 24(1): 74-80, 2022.

### Edited Special Issues of Journals and Books

56. I. Ulidowski, editor. Concurrency Theory and Applications '96. Proceedings of the 4th International RIMS Workshop, Kyoto University, 1997.

57. Irek Ulidowski, editor. Proceedings of the 6th AMAST Workshop on Real-time Systems ARTS 2004, Stirling, 2004. ***Electronic Notes in Theoretical Computer Science***, Volume 139, Issue 1,2005.

58. Luca Aceto, Wan Fokkink and Irek Ulidowski, editors. Proceedings of the 1st Workshop on Structural Operational Semantics (SOS 2004), London, 2004. ***Electronic Notes in Theoretical Computer Science***, Volume 128, Issue 1, 2005.

59. Peter Mosses and Irek Ulidowski, editors. Proceedings of the 2nd Workshop on Structural Operational Semantics (SOS 2005). ***Electronic Notes in Theoretical Computer Science***, Volume 156, Issue 1, 2006.

60. Peter Mosses and Irek Ulidowski, editors. Special issue of Theoretical Computer Science devoted to SOS 2005. ***Theoretical Computer Science***, 373(3), 2007.

61. Nicola Cannata, Emanuela Merelli and Irek Ulidowski, editors. Proceedings of the 2nd Workshop From Biology to Concurrency and back (FBTC 2008). ***Electronic Notes in Theoretical Computer Science***, volume 229(1), 2009.

62. Irek Ulidowski, editor. Proceedings of Reversible Computation 2009 (RC 2009). ***Electronic Notes in Theoretical Computer Science*** 253(6), 2010.

63. Nicola Cannata, Emanuela Merelli and Irek Ulidowski, editors. Special issue devoted to hybrid automata and oscillatory behaviour in biological systems. ***Theoretical Computer Science***, 411(20), 2010.

64. Rolf Drechsler, Irek Ulidowski and Robert Wille, editors. Special issue of Multiple-Valued Logic and Soft Computing devoted to Reversible Computation 2010. ***Multiple-Valued Logic and Soft Computing*** 18(1), 2012.

65. Maciej Koutny and Irek Ulidowski, editors. Proceedings of the 23rd International Conference on Concurrency Theory, CONCUR 2012, Newcastle upon Tyne, UK. Springer, LNCS 7454. 2012.

66. Maciej Koutny and Irek Ulidowski, editors. Special issue of ***Logical Methods in Computer Science*** devoted to CONCUR 2012. 2014.

67. Jarkko Kari, Irek Ulidowski, editors. Proceedings of Reversible Computation - 10th International Conference, RC 2018, Leicester, UK, September 12-14, 2018. Springer, LNCS 11106. 2018.

68. Irek Ulidowski, Ivan Lanese, Ulrik Pagh Schultz, Carla Ferreira, editors. Reversible Computation: Extending Horizons of Computing - Selected Results of the COST Action IC1405. Lecture Notes in Computer Science 12070, Springer LNCS 12070. 2020, ISBN 978-3-030-47360-0

## Grants

- University of Leicester Research Fund grant, £2,920, 1999.
- *SOS Workshop*, EPSRC, no. EP/C001885/1, £2,000, 2004.
- Overseas Travel Grant, EPSRC, no. EP/D001307/1, £7,270, 2006-08.
- *Reversible Computation Workshop*, EPSRC, grant EP/G039550/1, £6,000, 2009.
- Japan Society for the Promotion of Science (JSPS) Invitation Fellowship, £8,000, 2009.
- Two JSPS (London) Furusato Awards, £2,000 in 2010 and £2,000 in 2012.
- JSPS Invitation Fellowship to Nagoya University, £9,000, 2013.
- COST Action IC1405 on Reversible Computation, £480,000, 2015 - 2019.
- Marie Skłodowska-Curie Action Fellowship (Claudio Antares Mezzina), 186,400 EUR, 2018.
- JSPS Invitation Fellowship to Nagoya University, £10,000, 2021.

## International Research Networks and Collaboration

**Reversible Computation: Network**. I was the proposer and the chairman of COST Action IC1405 on Reversible Computation. The Action supports, coordinates and popularises an interdisciplinary research on foundations and applications of reversible computation. It involved over 160 scientists from computer science, mathematicians, physics and engineering from 28 European countries and 3 non-European countries (Algeria, Japan, USA). The main outcomes of the Action IC1405 were published in a Springer volume of LNCS [68].

**Reversible Computation: Conference**. Having been interested in unconventional models of computation for some time, and in reversible computation in particular, I established in 2009 an international workshop on Reversible Computation, RC for short, [49]. Toffoli, De Vos, Morita and Yokoyama, the world experts on physical and logical reversibility, gave invited talks, and the workshop was supported by an EPSRC grant. The RC workshops have taken place every year since then, and I take the leading rôle in their organisation and scientific content as the chair of the Steering Committee of RC. The workshop has grown to such an extent that, firstly, it became a two day event in 2010 and then in 2012 it was upgraded to a conference. Its proceedings appear in Springer's LNCS series. In 2010 I co-edited, jointly with Drechsler and Wille, a special issue of the Journal on Multiple-Valued Logic and Soft Computing devoted to Reversible Computation [51]. In 2018, the 10th Reversible Computation Conference took place in Leicester. Frank, Fredkin, Lanese, Margolus, and Ollinger were the invited speakers. There were also 21 papers presented at RC 2018 [54], with attendance of over 50 participants from 14 countries.

Co-proposer and host of **Marie Skłodowska-Curie Individual Fellowship** of Claudio Mezzina. The Fellowship aimed to research Reversible Causally-consistent Debugging of Concurrent Programs, and involves also Tuosto (Leicester), Yoshida and Phillips (Imperial College London), Lanese (Bologna), Vidal (Valencia), ans well as two software companies: Undo Software and Erlang Solutions.

**Concurrency Theory Conference**. The standing of my research and service to the Concurrency Theory community was recognised by allowing me to chair and organise, jointly with Koutny, the *23rd International Conference on Concurrency Theory* CONCUR 2012 which took place in Newcastle upon Tyne in 2012 [44-45]. This is only the second time in the history of this top international conference that it took place in the UK.

**Structural Operational Semantics**. In 2004 I established, jointly with Aceto and Fokkink, an international workshop devoted to Structural Operational Semantics. This workshop has taken place every year since then as a satellite event of the top international conferences CONCUR or ICALP. The 2004 workshop was supported by an EPSRC grant. Also, I co-organised jointly with Mosses the second SOS workshop and co-edited a special issue of TCS devoted to SOS [39].

**FBTC Workshop** Another aspect of my interest in unconventional computing was organisation, jointly with Cannata and Merelli, of the 2nd workshop From Biology to Concurrency and back (FBTC) 2008. We edited in 2010 a special issue of TCS devoted to the best papers of this workshop [42].

## Esteem in Professional Practice

1. I am on the Editorial Board of the Electronic Proceedings in Theoretical Computer Science, an international refereed open access venue for publications in Computer Science.

2. I am the Founding Members of International Federation for Information Processing (IFIP) WG 1.8 on Concurrency Theory.

3. Chairman of COST Action IC1405 on Reversible Computation.

4. Programme Committee Chair or the Organiser of international conferences: SOS 2004, SOS 2005, FBTC 2008, RC 2009, RC 2010, CONCUR 2012 and RC 2018.

5. Co-proposer and the host of Marie Skłodowska-Curie Individual Fellowship of Claudio Antares Mezzina, to work on Reversible causally-consistent debugging of of concurrent programs. The fellowship proposal achieved 97.5% score.

6. Selected Invited Addresses, Lectures and Seminars:

    - Invited lecture on Causal-consistent Reversibility of Imperative Parallel Programs at Nagoya University (August 2021) and JAIST, Kanazawa (August 2021), Japan.
    - Invited lecture on Reversing Imperative Parallel Programs for Debugging at Nagoya University (May 2017) and JAIST, Kanazawa (June 2017), Japan.
    - Invited seminar on Reversing Event Structures at Royal Holloway London, October 2015.
    - Invited address at the 4th IFIP WG 1.8 Workshop on Trends in Concurrency Theory, co-located with CONCUR 2015, Madrid, Spain. September 2015.
    - Invited address at the 6th Conference on *Reversible Computation 2014*, Kyoto, Japan. July 2014.
    - Invited address at the IFIP conference *Open Problems in Concurrency Theory* in Bertinoro, Italy. 2014.
    - Invited seminar on Reversing Event Structures for the Modelling of Bio-chemical Reactions at University of Buenos Aires, Argentina, September 2013.
    - Invited keynote lecture at the *Mathematical Theory of Processes and Operations Concurrent, Quantum, and More*, RIMS, Kyoto University, Japan. 2010.
    - Invited lecture at *Algebraic Process Calculi: The First Twenty Five Years and Beyond* in Bertinoro, Italy, 2005.
    - Invited lecture at *Process Algebra: Open Problems and Future Directions*, Betinoro, Italy, 2003.

## Management, Assessment and Supervision of Research

I managed the funds of the **COST Action IC1405** on Reversible Computation from 2015 to 2020. The funds amounted to between 125,000 and 155,000 EUR a year, and were used to organise two meetings of the Action a year, and support 20 to 25 Short Term Scientific Missions (STSMs) a year. I organised and run eight Action meetings, and assessed and evaluated over 80 STSMs. Jointly with Lanese I organised a Training School on Reversible Computation, which took place from 28 to 31 August 2017 in Toruń, Poland.

I am the supervisor of **Marie Skłodowska-Curie Individual Fellowship** of Claudio Mezzina. The fellowship supports research on Reversible Causally-consistent Debugging of Concurrent Programs. It is a two year collaborative project between Leicester (Ulidowski, Tuosto), Imperial College London, the University of Kent, Valencia University and two British software companies: Undo Software and Erlang Solutions.

**Project Assessment** Reviewer of research proposals for EPSRC, the Netherlands Organisation for Scientific Research (NWO, www.nwo.nl), the Icelandic Center for Research (www.rannis.is), the COST Association - European Commission in Science and Technology, and Agence Nationale de la Recherche (ARN) in France.

### Refereeing Duties

- Referee for major international journals: *Information and Computation*, *Theoretical Computer Science*, *ACM Transactions on Computational Logics*, *ACM Transactions on Programming Languages and Systems*, *Journal of Logic and Algebraic Programming*, *Fundamenta Informaticae*, *Logical Structures in Computer Science*, *Journal of Computer and System Sciences*, *Information Processing Letters*, *Transactions on Embedded Computing Systems*, *Science of Computer Programming*, *Natural Computing*.

- Programme Committee member of international conferences and workshops: EXPRESS 2004, ICTAC 2004, SOS 2004 - 2005, AMAST 2006, ATVA 2006 - 2007 and ATVA 2009, ACSD 2008 - 2010, RC 2009 - 2018, CONCUR 2011 - 2012, EXPRESS/SOS 2013 - 2015.

- Referee for major international conferences: CONCUR, LICS, FOSSACS, ICALP, POPL, AMAST, ACSD, CAV, MPC, MFCS, LATA, SOFTSEM, WADT, IFIP TCS, TGC.

## Support and Supervision of Research Students

### Supervision of Research Students

- Makoto Tanabe, PhD, Kyoto University, 1999.
- Gavin Cox, MPhil, University of Leicester, 2008.
- Nosheen Gul, PhD, University of Leicester, 2015.
- Daniel Morrison, PhD, University of Leicester, 2016.
- Stefan Kuhn, PhD, University of Leicester, 2018.
- James Hoey, PhD, University of Leicester, 2020.

### External PhD examining

- Koji Kagawa at Kyoto University in 1996,
- Susumu Nishimura at Kyoto University in 1997,
- Muhammad Atif at Technical University of Eindhoven in 2011,
- Anne Kersten Kauer at IMT Institute for Advanced Studies, Lucca, Italy in 2013,
- Doriana Medic at IMT Institute for Advanced Studies, Lucca, Italy in 2019.

**Midlands Graduate School**. I gave a series of lectures at the Midlands Graduate School in the Foundations of Computing Science. The lectures were on Concurrency Theory in 2001 and 2002, and on Reversible Computation in 2014. Attended by around 40 PhD students from the UK and abroad.

**Training School on Reversible Computation**. I organised jointly with Ivan Lanese the Training School on Reversible Computation. The school took place in August 2017 in Toruń, Poland, and was attended by over 50 participants and tutors.

One of the main aims of the COST Action IC1405 is to attract research students to Reversible Computation and to academic research in general. **Short Term Scientific Missions** are fully funded research visits by PhD students and early career researchers to centres of RC research. I have arranged and provided support for over 25 STSMs for PhD students over the last three years within the Action IC1405.

# Teaching

### Modules taught

- *Problem Solving with Computers*, University of North London, 1992 - 1993.
- *Data Structures and Algorithms*, University of North London, 1992 - 1993.
- *Artificial Intelligence Techniques*, University of North London, 1993 - 1994.
- *Operational Semantics*, RIMS, Kyoto University, 1994 - 1997.
- *Discrete Mathematics for Computer Science*, University of North London, 1998.
- *Information Systems*, University of Leicester, 1998 - 2006.
- *Communication and Concurrency*, University of Leicester, 1999 - 2019.
- *Study Skills and Professional Practice*, University of Leicester, 2012 - 2013.
- *Automata, Languages and Computation*, University of Leicester, 2017 - 2018.
- *Concurrent Systems*, University of Leicester, 2020-2021.
- *Foundations of Computation*, University of Leicester, 2018 - present.
- *Personal an Group Skills*, University of Leicester, 2021 - present.

**Other Teaching**. I delivered a series of lectures at the Midlands Graduate School in the Foundations of Computing Science. The lectures were on Concurrency Theory in 2001 and 2002, and on Reversible Computation in 2014.