Scheduled protocol programming

Dokter, K.P.C.

Bibliography

[AA16] Ramón Alonso-Sanz and Andy Adamatzky. Actin automata with memory. *Int. J. Bifurc. Chaos*, 26(1):1650019:1–1650019:14, 2016.

[ABB+14] Paul C. Attie, Eduard Baranov, Simon Bliudze, Mohamad Jaber, and Joseph Sifakis. A general framework for architecture composability. In Dimitra Giannakopoulou and Gwen Salaün, editors, *Software Engineering and Formal Methods - 12th International Conference, SEFM 2014, Grenoble, France, September 1-5, 2014. Proceedings*, volume 8702 of *Lecture Notes in Computer Science*, pages 128–143. Springer, 2014.

[ABC+08] Farhad Arbab, Roberto Bruni, Dave Clarke, Ivan Lanese, and Ugo Montanari. Tiles for reo. In Andrea Corradini and Ugo Montanari, editors, *Recent Trends in Algebraic Development Techniques, 19th International Workshop, WADT 2008, Pisa, Italy, June 13-16, 2008, Revised Selected Papers*, volume 5486 of *Lecture Notes in Computer Science*, pages 37–55. Springer, 2008.

[ABD+09] Krste Asanovic, Rastislav Bodík, James Demmel, Tony M. Keaveny, Kurt Keutzer, John Kubiatowicz, Nelson Morgan, David A. Patterson, Koushik Sen, John Wawrzynek, David Wessel, and Katherine A. Yelick. A view of the parallel computing landscape. *Commun. ACM*, 52(10):56–67, 2009.

[ABdBR04] Farhad Arbab, Christel Baier, Frank S. de Boer, and Jan J. M. M. Rutten. Models and temporal logics for timed component connectors. In *2nd International Conference on Software Engineering and Formal Methods (SEFM 2004), 28-30 September 2004, Beijing, China*, pages 198–207. IEEE Computer Society, 2004.

[ABdBR07] Farhad Arbab, Christel Baier, Frank S. de Boer, and Jan J. M. M. Rutten. Models and temporal logical specifications for timed component connectors. *Softw. Syst. Model.*, 6(1):59–82, 2007.

[ÁBJ16] 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, 2016.

[ACMM07] Farhad Arbab, Tom Chothia, Sun Meng, and Young-Joo Moon. Component connectors with qos guarantees. In Amy L. Murphy and Jan Vitek, editors, *Coordination Models and Languages, 9th International Conference, COORDINATION 2007, Paphos, Cyprus, June 6-8, 2007, Proceedings*, volume 4467 of *Lecture Notes in Computer Science*, pages 286–304. Springer, 2007.

[AD90] Rajeev Alur and David L. Dill. Automata for modeling real-time systems. In Mike Paterson, editor, *Proc. of ICALP*, volume 443 of *LNCS*, pages 322–335. Springer, 1990.

[AD94] Rajeev Alur and David L. Dill. A theory of timed automata. *Theor. Comput. Sci.*, 126(2):183–235, 1994.

[AGK01] Nikolay A. Anisimov, Evgeniy A. Golenkov, and Dmitriy I. Kharitonov. Compositional petri net approach to the development of concurrent and distributed systems. *Programming and Computer Software*, 27(6):309–319, 2001.

[AM02] Yasmina Abdeddaïm and Oded Maler. Preemptive job-shop scheduling using stopwatch automata. In Joost-Pieter Katoen and Perdita Stevens, editors, *Tools and Algorithms for the Construction and Analysis of Systems, 8th International Conference, TACAS 2002, Held as Part of the Joint European Conference on Theory and Practice of Software, ETAPS 2002, Grenoble, France, April 8-12, 2002, Proceedings*, volume 2280 of *Lecture Notes in Computer Science*, pages 113–126. Springer, 2002.

[AR02] Farhad Arbab and Jan J. M. M. Rutten. A coinductive calculus of component connectors. In Martin Wirsing, Dirk Pattinson, and Rolf Hennicker, editors, *Recent Trends in Algebraic Development Techniques, 16th International Workshop, WADT 2002, Frauenchiemsee, Germany, September 24-27, 2002, Revised Selected Papers*, volume 2755 of *Lecture Notes in Computer Science*, pages 34–55. Springer, 2002.

[Arb98] Farhad Arbab. What do you mean, coordination? In *Bulletin of the Dutch Association for Theoretical Computer Science (NVTI*, pages 11–22, 1998.

[Arb04] Farhad Arbab. Reo: a channel-based coordination model for component composition. *Math. Struct. Comput. Sci.*, 14(3):329–366, 2004.

[Arb11] Farhad Arbab. Puff, the magic protocol. In Gul Agha, Olivier Danvy, and José Meseguer, editors, *Formal Modeling: Actors, Open Systems, Biological Systems - Essays Dedicated to Carolyn Talcott on the Occasion of Her 70th Birthday*, volume 7000 of *LNCS*, pages 169–206. Springer, 2011.

[Arb16] Farhad Arbab. Proper protocol. In Ábrahám et al. [ÁBJ16], pages 65–87.

[AS12] Farhad Arbab and Francesco Santini. Preference and similarity-based behavioral discovery of services. In Maurice H. ter Beek and Niels Lohmann, editors, *Web Services and Formal Methods - 9th International Workshop, WS-FM 2012, Tallinn, Estonia, September 6-7, 2012, Revised Selected Papers*, volume 7843 of *Lecture Notes in Computer Science*, pages 118–133. Springer, 2012.

[BAC+09] Tomás Barros, Rabéa Ameur-Boulifa, Antonio Cansado, Ludovic Henrio, and Eric Madelaine. Behavioural models for distributed fractal components. *Ann. des Télécommunications*, 64(1-2):25–43, 2009.

[Bai05] Christel Baier. Probabilistic models for reo connector circuits. *J. Univers. Comput. Sci.*, 11(10):1718–1748, 2005.

[Bam14] Mohamed Ahmed Mohamed Bamakhrama. *On hard real-time scheduling of cyclo-static dataflow and its application in system-level design.* PhD thesis, Leiden University, 2014.

[BBKK09] Christel Baier, Tobias Blechmann, Joachim Klein, and Sascha Klüppelholz. A uniform framework for modeling and verifying components and connectors. In John Field and Vasco Thudichum Vasconcelos, editors, *Coordination Models and Languages, 11th International Conference, COORDINATION 2009, Lisboa, Portugal, June 9-12, 2009. Proceedings*, volume 5521 of *Lecture Notes in Computer Science*, pages 247–267. Springer, 2009.

[BBS06] Ananda Basu, Marius Bozga, and Joseph Sifakis. Modeling heterogeneous real-time components in BIP. In *Fourth IEEE International Conference on Software Engineering and Formal Methods (SEFM 2006), 11-15 September 2006, Pune, India*, pages 3–12. IEEE Computer Society, 2006.

[BCD+11] Lubos Brim, Jakub Chaloupka, Laurent Doyen, Raffaella Gentilini, and Jean-François Raskin. Faster algorithms for mean-payoff games. *Formal Methods Syst. Des.*, 38(2):97–118, 2011.

[BCH+97] Christel Baier, Edmund M. Clarke, Vasiliki Hartonas-Garmhausen, Marta Z. Kwiatkowska, and Mark Ryan. Symbolic model checking for probabilistic processes. In Pierpaolo Degano, Roberto Gorrieri, and Alberto Marchetti-Spaccamela, editors, *Automata, Languages and Programming, 24th International Colloquium, ICALP'97, Bologna, Italy, 7-11 July 1997, Proceedings*, volume 1256 of *Lecture Notes in Computer Science*, pages 430–440. Springer, 1997.

[BCL+06] Eric Bruneton, Thierry Coupaye, Matthieu Leclercq, Vivien Quéma, and Jean-Bernard Stefani. The FRACTAL component model and its support in java. *Softw., Pract. Exper.*, 36(11-12):1257–1284, 2006.

[BCM+92] Jerry R. Burch, Edmund M. Clarke, Kenneth L. McMillan, David L. Dill, and L. J. Hwang. Symbolic model checking: 10ˆ20 states and beyond. *Inf. Comput.*, 98(2):142–170, 1992.

[BCS12] Marcello M. Bonsangue, Dave Clarke, and Alexandra Silva. A model of context-dependent component connectors. *Sci. Comput. Program.*, 77(6):685–706, 2012.

[BdC92] Luca Bernardinello and Fiorella de Cindio. A survey of basic net models and modular net classes. In Rozenberg [Roz92], pages 304–351.

[BDH92] Eike Best, Raymond R. Devillers, and Jon G. Hall. The box calculus: a new causal algebra with multi-label communication. In Rozenberg [Roz92], pages 21–69.

[BG06] Stefano Bistarelli and Fabio Gadducci. Enhancing constraints manipulation in semiring-based formalisms. In Gerhard Brewka, Silvia Coradeschi, Anna Perini, and Paolo Traverso, editors, *ECAI 2006, 17th European Conference on Artificial Intelligence, August 29 - September 1, 2006, Riva del Garda, Italy, Including Prestigious Applications of Intelligent Systems (PAIS 2006), Proceedings*, volume 141 of *Frontiers in Artificial Intelligence and Applications*, pages 63–67. IOS Press, 2006.

[BGHJ09] Roderick Bloem, Karin Greimel, Thomas A. Henzinger, and Barbara Jobstmann. Synthesizing robust systems. In *Proc. of FMCAD*, pages 85–92. IEEE, 2009.

[BHM19] Simon Bliudze, Ludovic Henrio, and Eric Madelaine. Verification of concurrent design patterns with data. In Hanne Riis Nielson and Emilio Tuosto, editors, *Coordination Models and Languages - 21st IFIP WG 6.1 International Conference, COORDINATION 2019, Held as Part of the 14th International Federated Conference on Distributed Computing Techniques, DisCoTec 2019, Kongens Lyngby, Denmark, June 17-21, 2019, Proceedings*, volume 11533 of *Lecture Notes in Computer Science*, pages 161–181. Springer, 2019.

[bip16] BIP toolset, apr 2016.

[BK85] Jan A. Bergstra and Jan Willem Klop. Algebra of communicating processes with abstraction. *Theor. Comput. Sci.*, 37:77–121, 1985.

[BKK14] Christel Baier, Joachim Klein, and Sascha Klüppelholz. Synthesis of reo connectors for strategies and controllers. *Fundam. Informaticae*, 130(1):1–20, 2014.

[BM97] Roberto Bruni and Ugo Montanari. Zero-safe nets, or transition synchronization made simple. *Electr. Notes Theor. Comput. Sci.*, 7:55–74, 1997.

[BMM11] Roberto Bruni, Hernán C. Melgratti, and Ugo Montanari. Connector algebras, petri nets, and BIP. In Edmund M. Clarke, Irina B. Virbitskaite, and Andrei Voronkov, editors, *Perspectives of Systems Informatics - 8th International Andrei Ershov Memorial Conference,*

PSI 2011, Novosibirsk, Russia, June 27-July 1, 2011, Revised Selected Papers, volume 7162 of *Lecture Notes in Computer Science*, pages 19–38. Springer, 2011.

[BMMS16] Stefano Bistarelli, Fabio Martinelli, Ilaria Matteucci, and Francesco Santini. A formal and run-time framework for the adaptation of local behaviours to match a global property. In Olga Kouchnarenko and Ramtin Khosravi, editors, *Formal Aspects of Component Software - 13th International Conference, FACS 2016, Besançon, France, October 19-21, 2016, Revised Selected Papers*, volume 10231 of *Lecture Notes in Computer Science*, pages 134–152, 2016.

[BMR97] Stefano Bistarelli, Ugo Montanari, and Francesca Rossi. Semiring-based constraint satisfaction and optimization. *J. ACM*, 44(2):201–236, 1997.

[BMR06] Stefano Bistarelli, Ugo Montanari, and Francesca Rossi. Soft concurrent constraint programming. *ACM Trans. Comput. Log.*, 7(3):563–589, 2006.

[Bry86] Randal E. Bryant. Graph-based algorithms for boolean function manipulation. *IEEE Trans. Computers*, 35(8):677–691, 1986.

[BS07] Simon Bliudze and Joseph Sifakis. The algebra of connectors: structuring interaction in BIP. In Christoph M. Kirsch and Reinhard Wilhelm, editors, *Proceedings of the 7th ACM & IEEE International conference on Embedded software, EMSOFT 2007, September 30 - October 3, 2007, Salzburg, Austria*, pages 11–20. ACM, 2007.

[BSAR06] Christel Baier, Marjan Sirjani, Farhad Arbab, and Jan J. M. M. Rutten. Modeling component connectors in reo by constraint automata. *Sci. Comput. Program.*, 61(2):75–113, 2006.

[BSBJ14] Simon Bliudze, Joseph Sifakis, Marius Bozga, and Mohamad Jaber. Architecture internalisation in BIP. In Lionel Seinturier, Eduardo Santana de Almeida, and Jan Carlson, editors, *CBSE'14, Proceedings of the 17th International ACM SIGSOFT Symposium on Component-Based Software Engineering (part of CompArch 2014), Marcq-en-Baroeul, Lille, France, June 30 - July 4, 2014*, pages 169–178. ACM, 2014.

[CCA07] Dave Clarke, David Costa, and Farhad Arbab. Connector colouring I: synchronisation and context dependency. *Sci. Comput. Program.*, 66(3):205–225, 2007.

[CDB+16] Philipp Chrszon, Clemens Dubslaff, Christel Baier, Joachim Klein, and Sascha Klüppelholz. Modeling role-based systems with exogenous coordination. In Ábrahám et al. [ÁBJ16], pages 122–139.

[CDE+02] Manuel Clavel, Francisco Durán, Steven Eker, Patrick Lincoln, Narciso Martí-Oliet, José Meseguer, and Jose F. Quesada. Maude: specification and programming in rewriting logic. *Theor. Comput. Sci.*, 285(2):187–243, 2002.

[CDE+07] Manuel Clavel, Francisco Durán, Steven Eker, Patrick Lincoln, Narciso Martí-Oliet, José Meseguer, and Carolyn L. Talcott, editors. *All About Maude - A High-Performance Logical Framework, How to Specify, Program and Verify Systems in Rewriting Logic*, volume 4350 of *Lecture Notes in Computer Science*. Springer, 2007.

[CGK+13] Sjoerd Cranen, Jan Friso Groote, Jeroen J. A. Keiren, Frank P. M. Stappers, Erik P. de Vink, Wieger Wesselink, and Tim A. C. Willemse. An overview of the mcrl2 toolset and its recent advances. In Nir Piterman and Scott A. Smolka, editors, *Tools and Algorithms for the Construction and Analysis of Systems - 19th International Conference, TACAS 2013, Held as Part of the European Joint Conferences on Theory and Practice of Software, ETAPS 2013, Rome, Italy, March 16-24, 2013. Proceedings*, volume 7795 of *Lecture Notes in Computer Science*, pages 199–213. Springer, 2013.

[CL00] Franck Cassez and Kim Guldstrand Larsen. The impressive power of stopwatches. In Catuscia Palamidessi, editor, *CONCUR 2000 - Concurrency Theory, 11th International Conference, University Park, PA, USA, August 22-25, 2000, Proceedings*, volume 1877 of *Lecture Notes in Computer Science*, pages 138–152. Springer, 2000.

[CNR11] David Costa, Milad Niqui, and Jan J. M. M. Rutten. Intentional automata: A context-dependent model for component connectors - (extended abstract). In Farhad Arbab and Marjan Sirjani, editors, *Fundamentals of Software Engineering - 4th IPM International Conference, FSEN 2011, Tehran, Iran, April 20-22, 2011, Revised Selected Papers*, volume 7141 of *Lecture Notes in Computer Science*, pages 335–342. Springer, 2011.

[CPLA11] Dave Clarke, José Proença, Alexander Lazovik, and Farhad Arbab. Channel-based coordination via constraint satisfaction. *Sci. Comput. Program.*, 76(8):681–710, 2011.

[CR17] Carlo Comin and Romeo Rizzi. Improved pseudo-polynomial bound for the value problem and optimal strategy synthesis in mean payoff games. *Algorithmica*, 77(4):995–1021, 2017.

[CRBS08] Mohamed Yassin Chkouri, Anne Robert, Marius Bozga, and Joseph Sifakis. Translating AADL into BIP - application to the verification of real-time systems. In Michel R. V. Chaudron, editor, *Models in Software Engineering, Workshops and Symposia at MODELS 2008, Toulouse, France, September 28 - October 3, 2008. Reports and Revised Selected Papers*, volume 5421 of *Lecture Notes in Computer Science*, pages 5–19. Springer, 2008.

[DA17] Kasper Dokter and Farhad Arbab. Exposing latent mutual exclusion by work automata. In Mohammad Reza Mousavi and Jirí Sgall, editors, *Topics in Theoretical Computer Science - Second IFIP WG 1.8*

International Conference, TTCS 2017, Tehran, Iran, September 12-14, 2017, Proceedings, volume 10608 of *Lecture Notes in Computer Science*, pages 59–73. Springer, 2017.

[DA18a] Kasper Dokter and Farhad Arbab. Rule-based form for stream constraints. In Giovanna Di Marzo Serugendo and Michele Loreti, editors, *Coordination Models and Languages - 20th IFIP WG 6.1 International Conference, COORDINATION 2018, Held as Part of the 13th International Federated Conference on Distributed Computing Techniques, DisCoTec 2018, Madrid, Spain, June 18-21, 2018. Proceedings*, volume 10852 of *Lecture Notes in Computer Science*, pages 142–161. Springer, 2018.

[DA18b] Kasper Dokter and Farhad Arbab. Treo: Textual syntax for reo connectors. In Simon Bliudze and Saddek Bensalem, editors, *Proceedings of the 1st International Workshop on Methods and Tools for Rigorous System Design, MeTRiD@ETAPS 2018, Thessaloniki, Greece, 15th April 2018*, volume 272 of *EPTCS*, pages 121–135, 2018.

[DA21] Kasper Dokter and Farhad Arbab. Protocol scheduling. In Hossein Hojjat and Mieke Massink, editors, *Fundamentals of Software Engineering - 9th International Conference, FSEN 2021, Virtual Event, May 19-21, 2021, Revised Selected Papers*, volume 12818 of *Lecture Notes in Computer Science*, pages 3–17. Springer, 2021.

[dBBR18] Frank S. de Boer, Marcello M. Bonsangue, and Jan Rutten, editors. *It's All About Coordination - Essays to Celebrate the Lifelong Scientific Achievements of Farhad Arbab*, volume 10865 of *Lecture Notes in Computer Science*. Springer, 2018.

[DGLS21] Kasper Dokter, Fabio Gadducci, Benjamin Lion, and Francesco Santini. Soft constraint automata with memory. *J. Log. Algebraic Methods Program.*, 118:100615, 2021.

[DGS18] Kasper Dokter, Fabio Gadducci, and Francesco Santini. Soft constraint automata with memory. In de Boer et al. [dBBR18], pages 70–85.

[DJA16] Kasper Dokter, Sung-Shik Jongmans, and Farhad Arbab. Scheduling games for concurrent systems. In Alberto Lluch-Lafuente and José Proença, editors, *Coordination Models and Languages - 18th IFIP WG 6.1 International Conference, COORDINATION 2016, Held as Part of the 11th International Federated Conference on Distributed Computing Techniques, DisCoTec 2016, Heraklion, Crete, Greece, June 6-9, 2016, Proceedings*, volume 9686 of *Lecture Notes in Computer Science*, pages 84–100. Springer, 2016.

[DJAB15] Kasper Dokter, Sung-Shik Jongmans, Farhad Arbab, and Simon Bliudze. Relating BIP and reo. In Sophia Knight, Ivan Lanese, Alberto

Lluch-Lafuente, and Hugo Torres Vieira, editors, *Proceedings 8th Interaction and Concurrency Experience, ICE 2015, Grenoble, France, 4-5th June 2015*, volume 189 of *EPTCS*, pages 3–20, 2015.

[DJAB17] Kasper Dokter, Sung-Shik Jongmans, Farhad Arbab, and Simon Bliudze. Combine and conquer: Relating BIP and reo. *J. Log. Algebraic Methods Program.*, 86(1):134–156, 2017.

[DJL+15] Alexandre David, Peter Gjøl Jensen, Kim Guldstrand Larsen, Marius Mikucionis, and Jakob Haahr Taankvist. Uppaal stratego. In Christel Baier and Cesare Tinelli, editors, *Tools and Algorithms for the Construction and Analysis of Systems - 21st International Conference, TACAS 2015, Held as Part of the European Joint Conferences on Theory and Practice of Software, ETAPS 2015, London, UK, April 11-18, 2015. Proceedings*, volume 9035 of *Lecture Notes in Computer Science*, pages 206–211. Springer, 2015.

[DKV09] Manfred Droste, Werner Kuich, and Heiko Vogler. *Handbook of weighted automata*. Springer Science & Business Media, 2009.

[Dok19] Kasper Dokter. Multilabeled petri nets. In Farhad Arbab and Sung-Shik Jongmans, editors, *Formal Aspects of Component Software - 16th International Conference, FACS 2019, Amsterdam, The Netherlands, October 23-25, 2019, Proceedings*, volume 12018 of *Lecture Notes in Computer Science*, pages 106–126. Springer, 2019.

[ECT] Extensible coordination tools ECT. `http://reo.project.cwi.nl`. Accessed: 2018-03-23.

[Ehl10] Rüdiger Ehlers. Minimising deterministic büchi automata precisely using SAT solving. In Ofer Strichman and Stefan Szeider, editors, *Theory and Applications of Satisfiability Testing - SAT 2010, 13th International Conference, SAT 2010, Edinburgh, UK, July 11-14, 2010. Proceedings*, volume 6175 of *Lecture Notes in Computer Science*, pages 326–332. Springer, 2010.

[EM79] A. Ehrenfeucht and J. Mycielski. Positional strategies for mean payoff games. *Int. J. Game Theory*, 8(2):109–113, 1979.

[Feh91] Rainer Fehling. A concept of hierarchical petri nets with building blocks. In Grzegorz Rozenberg, editor, *Advances in Petri Nets 1993, Papers from the 12th International Conference on Applications and Theory of Petri Nets, Gjern, Denmark, June 1991*, volume 674 of *Lecture Notes in Computer Science*, pages 148–168. Springer, 1991.

[FMS14] Sanford Friedenthal, Alan Moore, and Rick Steiner. *A practical guide to SysML: the systems modeling language*. Morgan Kaufmann, 2014.

[GHMW13] Fabio Gadducci, Matthias M. Hölzl, Giacoma Valentina Monreale, and Martin Wirsing. Soft constraints for lexicographic orders. In

Félix Castro-Espinoza, Alexander F. Gelbukh, and Miguel González-Mendoza, editors, *Advances in Artificial Intelligence and Its Applications - 12th Mexican International Conference on Artificial Intelligence, MICAI 2013, Mexico City, Mexico, November 24-30, 2013, Proceedings, Part I*, volume 8265 of *Lecture Notes in Computer Science*, pages 68–79. Springer, 2013.

[GJ92] Eric Goubault and Thomas P. Jensen. Homology of higher dimensional automata. In Rance Cleaveland, editor, *CONCUR '92, Third International Conference on Concurrency Theory, Stony Brook, NY, USA, August 24-27, 1992, Proceedings*, volume 630 of *Lecture Notes in Computer Science*, pages 254–268. Springer, 1992.

[GM00] Fabio Gadducci and Ugo Montanari. The tile model. In Gordon D. Plotkin, Colin Stirling, and Mads Tofte, editors, *Proof, Language, and Interaction, Essays in Honour of Robin Milner*, pages 133–166. The MIT Press, 2000.

[Gol88] Ursula Goltz. On representing CCS programs by finite petri nets. In Michal Chytil, Ladislav Janiga, and Václav Koubek, editors, *Mathematical Foundations of Computer Science 1988, MFCS'88, Carlsbad, Czechoslovakia, August 29 - September 2, 1988, Proceedings*, volume 324 of *Lecture Notes in Computer Science*, pages 339–350. Springer, 1988.

[Gol03] J. Golan. *Semirings and Affine Equations over Them: Theory and Applications*. Kluwer, 2003.

[Gou95] Eric Goubault. Schedulers as abstract interpretations of higher-dimensional automata. In *Proc. of PEPM*, pages 134–145. ACM, 1995.

[Gra66] R.L. Graham. Bounds for certain multiprocessing anomalies. *The Bell System Technical Journal*, 1966.

[GS17] Fabio Gadducci and Francesco Santini. Residuation for bipolar preferences in soft constraints. *Inf. Process. Lett.*, 118:69–74, 2017.

[GSPV15] Fabio Gadducci, Francesco Santini, Luis Fernando Pino, and Frank D. Valencia. A labelled semantics for soft concurrent constraint programming. In Holvoet and Viroli [HV15], pages 133–149.

[GSPV17] Fabio Gadducci, Francesco Santini, Luis Fernando Pino, and Frank D. Valencia. Observational and behavioural equivalences for soft concurrent constraint programming. *Logical and Algebraic Methods in Programmming*, 92:45–63, 2017.

[Gun01] Jeremy Gunawardena. Homotopy and concurrency. In Gheorghe Paun, Grzegorz Rozenberg, and Arto Salomaa, editors, *Current Trends in Theoretical Computer Science, Entering the 21th Century*, pages 447–459. World Scientific, 2001.

[Hen00] Thomas A Henzinger. The theory of hybrid automata. In M. Kemal Inan and Robert P. Kurshan, editors, *Verification of Digital and Hybrid Systems*, pages 265–292. Springer, 2000.

[HMT81] Leon Henkin, J Donald Monk, and Alfred Tarski. Cylindric set algebras and related structures. In *Cylindric Set Algebras*, pages 1–129. Springer, 1981.

[Hoa78] C. A. R. Hoare. Communicating sequential processes. *Commun. ACM*, 21(8):666–677, 1978.

[Hol04] Gerard J. Holzmann. *The SPIN Model Checker - primer and reference manual*. Addison-Wesley, 2004.

[HU67] John E. Hopcroft and Jeffrey D. Ullman. Nonerasing stack automata. *J. Comput. Syst. Sci.*, 1(2):166–186, 1967.

[HV15] Tom Holvoet and Mirko Viroli, editors. *Coordination Models and Languages - 17th IFIP WG 6.1 International Conference, COORDINATION 2015, Held as Part of the 10th International Federated Conference on Distributed Computing Techniques, DisCoTec 2015, Grenoble, France, June 2-4, 2015, Proceedings*, volume 9037 of *Lecture Notes in Computer Science*. Springer, 2015.

[IBC08] Mohammad Izadi, Marcello M. Bonsangue, and Dave Clarke. Modeling component connectors: Synchronisation and context-dependency. In Antonio Cerone and Stefan Gruner, editors, *Sixth IEEE International Conference on Software Engineering and Formal Methods, SEFM 2008, Cape Town, South Africa, 10-14 November 2008*, pages 303–312. IEEE Computer Society, 2008.

[JA12] Sung-Shik T. Q. Jongmans and Farhad Arbab. Overview of thirty semantic formalisms for reo. *Sci. Ann. Comp. Sci.*, 22(1):201–251, 2012.

[JA15] Sung-Shik T. Q. Jongmans and Farhad Arbab. Take command of your constraints! In Holvoet and Viroli [HV15], pages 117–132.

[JA16a] Sung-Shik T. Q. Jongmans and Farhad Arbab. Data optimizations for constraint automata. *Logical Methods in Computer Science*, 12(3), 2016.

[JA16b] Sung-Shik T. Q. Jongmans and Farhad Arbab. Prdk: Protocol programming with automata. In Marsha Chechik and Jean-François Raskin, editors, *Tools and Algorithms for the Construction and Analysis of Systems - 22nd International Conference, TACAS 2016, Held as Part of the European Joint Conferences on Theory and Practice of Software, ETAPS 2016, Eindhoven, The Netherlands, April 2-8, 2016, Proceedings*, volume 9636 of *Lecture Notes in Computer Science*, pages 547–552. Springer, 2016.

[JA18] Sung-Shik T. Q. Jongmans and Farhad Arbab. Centralized coordination vs. partially-distributed coordination with reo and constraint automata. *Sci. Comput. Program.*, 160:48–77, 2018.

[JCP16] Sung-Shik T. Q. Jongmans, Dave Clarke, and José Proença. A procedure for splitting data-aware processes and its application to coordination. *Sci. Comput. Program.*, 115-116:47–78, 2016.

[JHA14] Sung-Shik T. Q. Jongmans, Sean Halle, and Farhad Arbab. Automata-based optimization of interaction protocols for scalable multicore platforms. In eva Kühn and Rosario Pugliese, editors, *Coordination Models and Languages - 16th IFIP WG 6.1 International Conference, COORDINATION 2014, Held as Part of the 9th International Federated Conferences on Distributed Computing Techniques, DisCoTec 2014, Berlin, Germany, June 3-5, 2014, Proceedings*, volume 8459 of *Lecture Notes in Computer Science*, pages 65–82. Springer, 2014.

[JKA11] Sung-Shik T. Q. Jongmans, Christian Krause, and Farhad Arbab. Encoding context-sensitivity in reo into non-context-sensitive semantic models. In Wolfgang De Meuter and Gruia-Catalin Roman, editors, *Coordination Models and Languages - 13th International Conference, COORDINATION 2011, Reykjavik, Iceland, June 6-9, 2011. Proceedings*, volume 6721 of *Lecture Notes in Computer Science*, pages 31–48. Springer, 2011.

[JKA17] Sung-Shik T. Q. Jongmans, Tobias Kappé, and Farhad Arbab. Constraint automata with memory cells and their composition. *Sci. Comput. Program.*, 146:50–86, 2017.

[Jon16] S.-S. T. Q. Jongmans. *Automata-theoretic protocol programming*. PhD thesis, Leiden University, 2016.

[Kan09] Krishna Kant. Data center evolution: A tutorial on state of the art, issues, and challenges. *Comput. Networks*, 53(17):2939–2965, 2009.

[KAT16] Tobias Kappé, Farhad Arbab, and Carolyn L. Talcott. A compositional framework for preference-aware agents. In Mehdi Kargahi and Ashutosh Trivedi, editors, *Proceedings of the The First Workshop on Verification and Validation of Cyber-Physical Systems, V2CPS@IFM 2016, Reykjavík, Iceland, June 4-5, 2016*, volume 232 of *EPTCS*, pages 21–35, 2016.

[KAT17] Tobias Kappé, Farhad Arbab, and Carolyn L. Talcott. A component-oriented framework for autonomous agents. In José Proença and Markus Lumpe, editors, *Formal Aspects of Component Software - 14th International Conference, FACS 2017, Braga, Portugal, October 10-13, 2017, Proceedings*, volume 10487 of *Lecture Notes in Computer Science*, pages 20–38. Springer, 2017.

[KC09] Christian Koehler and Dave Clarke. Decomposing port automata. In Sung Y. Shin and Sascha Ossowski, editors, *Proceedings of the 2009*

ACM Symposium on Applied Computing (SAC), Honolulu, Hawaii, USA, March 9-12, 2009, pages 1369–1373. ACM, 2009.

[Kem12] S. Kemper. Sat-based verification for timed component connectors. *Sci. Comput. Program.*, 77(7-8):779–798, 2012.

[KKdV12] Natallia Kokash, Christian Krause, and Erik P. de Vink. Reo + mcrl2: A framework for model-checking dataflow in service compositions. *Formal Aspects Comput.*, 24(2):187–216, 2012.

[Klü12] Sascha Klüppelholz. *Verification of Branching-Time and Alternating-Time Properties for Exogenous Coordination Models.* PhD thesis, Dresden University of Technology, 2012.

[KNSW07] Marta Z. Kwiatkowska, Gethin Norman, Jeremy Sproston, and Fuzhi Wang. Symbolic model checking for probabilistic timed automata. *Inf. Comput.*, 205(7):1027–1077, 2007.

[Kot78] Vadim E. Kotov. An algebra for parallelism based on petri nets. In Józef Winkowski, editor, *Mathematical Foundations of Computer Science 1978, Proceedings, 7th Symposium, Zakopane, Poland, September 4-8, 1978*, volume 64 of *Lecture Notes in Computer Science*, pages 39–55. Springer, 1978.

[Kra09] Christian Krause. Integrated structure and semantics for reo connectors and petri nets. In Filippo Bonchi, Davide Grohmann, Paola Spoletini, and Emilio Tuosto, editors, *Proceedings 2nd Interaction and Concurrency Experience: Structured Interactions, ICE 2009, Bologna, Italy, 31st August 2009*, volume 12 of *EPTCS*, pages 57–69, 2009.

[Kru95] Philippe Kruchten. The 4+1 view model of architecture. *IEEE Software*, 12(6):42–50, 1995.

[MA09] Sun Meng and Farhad Arbab. Qos-driven service selection and composition using quantitative constraint automata. *Fundam. Informaticae*, 95(1):103–128, 2009.

[Mar75] Donald A Martin. Borel determinacy. *Annals of Mathematics*, pages 363–371, 1975.

[Maz95] Antoni W. Mazurkiewicz. Introduction to trace theory. In Volker Diekert and Grzegorz Rozenberg, editors, *The Book of Traces*, pages 3–41. World Scientific, 1995.

[Mil89] Robin Milner. *Communication and Concurrency*, volume 84. Prentice-Hall, Inc., 1989.

[MM90] José Meseguer and Ugo Montanari. Petri nets are monoids. *Inf. Comput.*, 88(2):105–155, 1990.

[MSKA14] Young-Joo Moon, Alexandra Silva, Christian Krause, and Farhad Arbab. A compositional model to reason about end-to-end qos in stochastic reo connectors. *Sci. Comput. Program.*, 80:3–24, 2014.

[Mur89] Tadao Murata. Petri nets: Properties, analysis and applications. *Proceedings of the IEEE*, 77(4):541–580, 1989.

[OMG06] OMG. CORBA component model, v4.0, OMG document formal/06-04-01, 2006. visited 11-13-2017.

[PA98] George A. Papadopoulos and Farhad Arbab. Coordination models and languages. *Adv. Comput.*, 46:329–400, 1998.

[PA01] George A. Papadopoulos and Farhad Arbab. Configuration and dynamic reconfiguration of components using the coordination paradigm. *Future Gener. Comput. Syst.*, 17(8):1023–1038, 2001.

[Par13] Terence Parr. *The definitive ANTLR 4 reference*. Pragmatic Bookshelf, 2013.

[PC08] José Proença and Dave Clarke. Coordination models orc and reo compared. *Electron. Notes Theor. Comput. Sci.*, 194(4):57–76, 2008.

[PCdVA12] José Proença, Dave Clarke, Erik P. de Vink, and Farhad Arbab. Dreams: a framework for distributed synchronous coordination. In Sascha Ossowski and Paola Lecca, editors, *Proceedings of the ACM Symposium on Applied Computing, SAC 2012, Riva, Trento, Italy, March 26-30, 2012*, pages 1510–1515. ACM, 2012.

[PR89] Amir Pnueli and Roni Rosner. On the synthesis of a reactive module. In *Conference Record of the Sixteenth Annual ACM Symposium on Principles of Programming Languages, Austin, Texas, USA, January 11-13, 1989*, pages 179–190. ACM Press, 1989.

[PR90] Amir Pnueli and Roni Rosner. Distributed reactive systems are hard to synthesize. In *31st Annual Symposium on Foundations of Computer Science, St. Louis, Missouri, USA, October 22-24, 1990, Volume II*, pages 746–757. IEEE Computer Society, 1990.

[Pra86] Vaughan R. Pratt. Modeling concurrency with partial orders. *Int. J. Parallel Program.*, 15(1):33–71, 1986.

[Pra91] Vaughan R. Pratt. Modeling concurrency with geometry. In Wise [Wis91], pages 311–322.

[Rei13] Wolfgang Reisig. *Understanding Petri Nets - Modeling Techniques, Analysis Methods, Case Studies*. Springer, 2013.

[Reo] Reolanguage github repository. `https://github.com/ReoLanguage/Reo`. Accessed: 2018-03-23.

[reo16] Reo toolset, apr 2016.

[Roz92] Grzegorz Rozenberg, editor. *Advances in Petri Nets 1992, The DEMON Project*, volume 609 of *Lecture Notes in Computer Science*. Springer, 1992.

[Rut01] Jan J. M. M. Rutten. Elements of stream calculus (an extensive exercise in coinduction). *Electr. Notes Theor. Comput. Sci.*, 45:358–423, 2001.

[Sch86] David A. Schmidt. *Denotational Semantics: A Methodology for Language Development*. William C. Brown Publishers, Dubuque, IA, USA, 1986.

[SRP91] Vijay A. Saraswat, Martin C. Rinard, and Prakash Panangaden. Semantic foundations of concurrent constraint programming. In Wise [Wis91], pages 333–352.

[SSAA13] Mahdi Sargolzaei, Francesco Santini, Farhad Arbab, and Hamideh Afsarmanesh. A tool for behaviour-based discovery of approximately matching web services. In Robert M. Hierons, Mercedes G. Merayo, and Mario Bravetti, editors, *Software Engineering and Formal Methods - 11th International Conference, SEFM 2013, Madrid, Spain, September 25-27, 2013. Proceedings*, volume 8137 of *Lecture Notes in Computer Science*, pages 152–166. Springer, 2013.

[Tal18] Carolyn L. Talcott. From soft agents to soft component automata and back. In de Boer et al. [dBBR18], pages 189–207.

[Tau89] Dirk Taubner. *Finite Representations of CCS and TCSP Programs by Automata and Petri Nets*, volume 369 of *Lecture Notes in Computer Science*. Springer, 1989.

[TNAK16] Carolyn L. Talcott, Vivek Nigam, Farhad Arbab, and Tobias Kappé. Formal specification and analysis of robust adaptive distributed cyber-physical systems. In Marco Bernardo, Rocco De Nicola, and Jane Hillston, editors, *Formal Methods for the Quantitative Evaluation of Collective Adaptive Systems - 16th International School on Formal Methods for the Design of Computer, Communication, and Software Systems, SFM 2016, Bertinoro, Italy, June 20-24, 2016, Advanced Lectures*, volume 9700 of *Lecture Notes in Computer Science*, pages 1–35. Springer, 2016.

[TSR11] Carolyn L. Talcott, Marjan Sirjani, and Shangping Ren. Comparing three coordination models: Reo, arc, and PBRD. *Sci. Comput. Program.*, 76(1):3–22, 2011.

[Val90] Leslie G. Valiant. A bridging model for parallel computation. *Commun. ACM*, 33(8):103–111, 1990.

[vG91] Rob J. van Glabbeek. Bisimulation semantics for higher dimensional automata. Email message, July 1991.

[vG06] Rob J. van Glabbeek. On the expressiveness of higher dimensional automata. *Theor. Comput. Sci.*, 356(3):265–290, 2006.

[vGV87] Rob J. van Glabbeek and Frits W. Vaandrager. Petri net models for algebraic theories of concurrency. In J. W. de Bakker, A. J. Nijman, and Philip C. Treleaven, editors, *PARLE, Parallel Architectures and Languages Europe, Volume II: Parallel Languages, Eindhoven, The Netherlands, June 15-19, 1987, Proceedings*, volume 259 of *Lecture Notes in Computer Science*, pages 224–242. Springer, 1987.

[vGV97] Rob J. van Glabbeek and Frits W. Vaandrager. The difference between splitting in n and n+1. *Inf. Comput.*, 136(2):109–142, 1997.

[VW02] Walter Vogler and Ralf Wollowski. Decomposition in asynchronous circuit design. In Jordi Cortadella, Alexandre Yakovlev, and Grzegorz Rozenberg, editors, *Concurrency and Hardware Design, Advances in Petri Nets*, volume 2549 of *Lecture Notes in Computer Science*, pages 152–190. Springer, 2002.

[Wim04] Harro Wimmel. Eliminating internal behaviour in petri nets. In Jordi Cortadella and Wolfgang Reisig, editors, *Applications and Theory of Petri Nets 2004, 25th International Conference, ICATPN 2004, Bologna, Italy, June 21-25, 2004, Proceedings*, volume 3099 of *Lecture Notes in Computer Science*, pages 411–425. Springer, 2004.

[Win87] Glynn Winskel. Petri nets, algebras, morphisms, and compositionality. *Inf. Comput.*, 72(3):197–238, 1987.

[Wis91] David S. Wise, editor. *Conference Record of the Eighteenth Annual ACM Symposium on Principles of Programming Languages, Orlando, Florida, USA, January 21-23, 1991.* ACM Press, 1991.

[WN95] Glynn Winskel and Mogens Nielsen. Models for concurrency. In *Handbook of Logic in Computer Science*, volume 4, pages 1–148. Oxford University Press, 1995.

Appendix A

Original CSDF program

```
import multiprocessing as mp
import queue
import psutil
import time

def dummy_work(duration):
    a = 1
    for i in range(duration * 100000):
        a = (a * i) % 10000

def put_or_lose(e):
    try:
        e.put_nowait(True)
    except queue.Full:
        pass

def A1(e1, e2, e3):
    wcet = 5
    psutil.Process().cpu_affinity([0,1])
    while True:
        dummy_work(wcet)
        put_or_lose(e1)
        put_or_lose(e3)
        dummy_work(wcet)
        put_or_lose(e1)
        put_or_lose(e3)
        dummy_work(wcet)
        put_or_lose(e2)
        put_or_lose(e3)

def A2(e1, e4):
    wcet = 8
    psutil.Process().cpu_affinity([0,1])
    while True:
        e1.get()
```

```
        dummy_work(wcet)
        put_or_lose(e4)

def A3(e2, e5):
    wcet = 24
    psutil.Process().cpu_affinity([0,1])
    while True:
        e2.get()
        dummy_work(wcet)
        put_or_lose(e5)

def A4(e3, e4, e5):
    wcet = 4
    psutil.Process().cpu_affinity([0,1])
    throughputs = []
    while len(throughputs) < 500:
        t = time.time()
        dummy_work(wcet)
        e3.get()
        e4.get()
        dummy_work(wcet)
        e3.get()
        e4.get()
        dummy_work(wcet)
        e3.get()
        e5.get()
        throughputs.append(round(1000*(time.time()-t)))
    print(throughputs)

if __name__ == '__main__':
    e1 = mp.Queue(50)
    e2 = mp.Queue(50)
    e3 = mp.Queue(50)
    e4 = mp.Queue(50)
    e5 = mp.Queue(50)
    A = [
        mp.Process(target=A1,args=(e1, e2, e3), daemon=True),
        mp.Process(target=A2,args=(e1, e4), daemon=True),
        mp.Process(target=A3,args=(e2, e5), daemon=True),
        mp.Process(target=A4,args=(e3, e4, e5), daemon=True)
    ]
    for p in A:
        p.start()
    A[3].join()
```

Appendix B

Scheduled CSDF program

```
import multiprocessing as mp
import queue
import psutil
import time

def dummy_work(duration):
    a = 1
    for i in range(duration * 100000):
        a = (a * i) % 10000

def put_or_lose(e):
    try:
        e.put_nowait(True)
    except queue.Full:
        pass

def A1(e1, e2, e3, b):
    wcet = 5
    psutil.Process().cpu_affinity([0,1])
    while True:
        b.wait()
        dummy_work(wcet)
        put_or_lose(e1)
        put_or_lose(e3)
        b.wait()
        b.wait()
        dummy_work(wcet)
        put_or_lose(e1)
        put_or_lose(e3)
        b.wait()
        b.wait()
        dummy_work(wcet)
        put_or_lose(e2)
        put_or_lose(e3)
        b.wait()
```

```
def A2(e1, e4, b):
    wcet = 8
    psutil.Process().cpu_affinity([0,1])
    while True:
        b.wait()
        e1.get()
        dummy_work(wcet)
        put_or_lose(e4)
        b.wait()

def A3(e2, e5, b):
    wcet = 24
    psutil.Process().cpu_affinity([0,1])
    while True:
        b.wait()
        e2.get()
        dummy_work(wcet)
        put_or_lose(e5)
        b.wait()

def A4(e3, e4, e5, b):
    wcet = 4
    psutil.Process().cpu_affinity([0,1])
    throughputs = []
    while len(throughputs) < 500:
        t = time.time()
        b.wait()
        dummy_work(wcet)
        e3.get()
        e4.get()
        b.wait()
        b.wait()
        dummy_work(wcet)
        e3.get()
        e4.get()
        b.wait()
        b.wait()
        dummy_work(wcet)
        e3.get()
        e5.get()
        b.wait()
        throughputs.append(round(1000*(time.time()-t)))
    print(throughputs)

def Scheduler(b1, b2, b3, b4):
    b1.wait()
    b1.wait()
    b1.wait()
    b2.wait()
    b1.wait()
    b1.wait()
```

```
    b2.wait()
    b4.wait()
    b1.wait()
    b3.wait()
    b4.wait()
    while True:
        b2.wait()
        b2.wait()
        b4.wait()
        b4.wait()
        b1.wait()
        b1.wait()
        b3.wait()
        b1.wait()
        b4.wait()
        b4.wait()
        b2.wait()
        b1.wait()
        b1.wait()
        b1.wait()
        b3.wait()
        b2.wait()
        b4.wait()
        b4.wait()

if __name__ == '__main__':
    e1 = mp.Queue(50)
    e2 = mp.Queue(50)
    e3 = mp.Queue(50)
    e4 = mp.Queue(50)
    e5 = mp.Queue(50)
    b1 = mp.Barrier(2)
    b2 = mp.Barrier(2)
    b3 = mp.Barrier(2)
    b4 = mp.Barrier(2)
    A = [
        mp.Process(target=A1,args=(e1,e2,e3,b1),daemon=True),
        mp.Process(target=A2,args=(e1,e4,b2),daemon=True),
        mp.Process(target=A3,args=(e2,e5,b3),daemon=True),
        mp.Process(target=A4,args=(e3,e4,e5,b4),daemon=True),
        mp.Process(
          target=Scheduler,
          args=(b1,b2,b3,b4),
          daemon=True
        )
    ]
    for p in A:
        p.start()
    A[3].join()
```

Curriculum Vitae

Born in 1990 in Putten.

Education

- 1994-2002: Basisschool met de Bijbel Huinen, Putten
- 2002-2007: Havo, Johannes Fontanus College, Barneveld
- 2007-2008: Propedeuse mechanical engineering, Windesheim, Zwolle
- 2008-2011: BSc Wiskunde (cum laude), Utrecht University
- 2011-2013: MSc Mathematical sciences (cum laude), Utrecht University

Employment

- 2014-2017: Doctoral candidate, Centrum Wiskunde & Informatica
- 2017-2019: Doctoral candidate, Leiden University
- 2018-2022: Financial data analyst, SoliTrust, Apeldoorn
- 2019-2021: Member of ECiDA project, Centrum Wiskunde & Informatica
- 2022-Now: Data scientist and software engineer, self-employed

List of Publications

The results of this dissertation are based on the following publications:

Journal Articles

- Kasper Dokter, Fabio Gadducci, Benjamin Lion, Francesco Santini: Soft constraint automata with memory. *J. Log. Algebraic Methods Program.* 118: 100615 (2021)
- Kasper Dokter, Sung-Shik Jongmans, Farhad Arbab, Simon Bliudze: Combine and conquer: Relating BIP and Reo. *J. Log. Algebraic Methods Program.* 86(1): 134-156 (2017)

Conference Papers

- Kasper Dokter, Farhad Arbab: Protocol Scheduling. *FSEN 2021*: 3-17
- Kasper Dokter: Multilabeled Petri Nets. *FACS 2019*: 106-126
- Kasper Dokter, Fabio Gadducci, Francesco Santini: Soft Constraint Automata with Memory. *It's All About Coordination 2018*: 70-85
- Kasper Dokter, Farhad Arbab: Rule-Based Form for Stream Constraints. COORDINATION 2018: 142-161
- Kasper Dokter, Farhad Arbab: Treo: Textual Syntax for Reo Connectors. *MeTRiD@ETAPS 2018*: 121-135
- Kasper Dokter, Farhad Arbab: Exposing Latent Mutual Exclusion by Work Automata. *TTCS 2017*: 59-73
- Kasper Dokter, Sung-Shik Jongmans, Farhad Arbab: Scheduling Games for Concurrent Systems. *COORDINATION 2016*: 84-100
- Kasper Dokter, Sung-Shik Jongmans, Farhad Arbab, Simon Bliudze: Relating BIP and Reo. *ICE 2015*: 3-20