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Formal Modeling: Actors, Open Systems, Biological Systems

Essays Dedicated to Carolyn Talcott
on the Occasion of Her 70th Birthday

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Dr. Carolyn Talcott

Preface

This volume contains the papers presented at a symposium in honor of Carolyn Talcott held during November 3–4, 2011 in Menlo Park, California.

Carolyn Talcott, who celebrated her 70th birthday in 2011, is a leading researcher and mentor of international renown among computer scientists. Dr. Talcott has made key contributions to a number of areas of computer science including:

1. Semantics and verification of programming languages
2. Foundations of Actor-based systems
3. Middleware and meta-architectures
4. Maude and rewriting logic
5. Computational biology

Dr. Talcott's earliest contributions to the semantics and verification of programming languages started with her PhD thesis and continued with her work on the Actor model. Her thesis addressed the challenging problem of formalizing reasoning about state change in high-level languages like LISP. The proof methods she developed for reasoning about state change are widely cited; she was recognized as a leading figure in the field, serving in key positions such as Co-Editor-in-Chief of Springer's journal *LISP and Symbolic Computation* and then *Higher-Order and Symbolic Computation* (HOSC), and in roles such as chair or co-organizer of many scientific meetings in the field.

Dr. Talcott made substantial contributions to advancing the formal development of the Actor model. Actors are a foundational model of concurrency; they capture the asynchronous nature of parallel and distributed systems, and provide the flexibility needed to build open, extensible concurrent systems. In recent years, the Actor model has acquired increasing importance and use, providing a basis for a number of programming languages and frameworks. The growth of the model is due to the fact that Actors go a long way toward addressing the challenges of programmability in systems such as Web services, cloud computing and scalable multicore processor architectures. Her seminal contributions to the foundations and formal reasoning techniques for Actors not only defines the state of the art today but provides the foundation for future developments in this field.

Computer systems and applications are not only increasingly distributed, they also need to deal with changing physical constraints such as energy and real-time requirements, sensing and actuation control loops, as well as security, reliability, etc. Designing such systems so that they can flexibly adapt to changing conditions and remain resilient and safe is an enormous challenge. Dr. Talcott's contributions address this challenge by developing methods for reasoning about novel distributed object reflection techniques whereby "meta-objects" can monitor and control the runtime state of other objects (which could in turn themselves be meta-objects controlling lower-level meta-objects). The techiques she developed are not only mathematically well-founded, they provide practical methods for building adaptive middleware. In particular, her work on the Two-Level Actor Machine (TLAM) model, and on the "Russian Dolls" model of distributed reflection is well known. These methods are having, and will continue to have, a significant impact in the emerging area of cyber-physical systems.

During her tenure as a senior scientist at Stanford University, Dr. Talcott began research which has led to a series of key conceptual contributions to rewriting logic and Maude–arguably the most advanced executable formal specification language currently available. These contributions included definition of the semantics of Actors and Actor languages in rewriting logic, and the development of formal reasoning systems. After her retirement from Stanford, Dr. Talcott moved to SRI in 2001 to head the Maude team and her contributions have been even more significant. Thanks in no small part to these contributions, Maude has gained a scientific network consisting of several universities across Europe, as well as institutions in the USA. A Springer LNCS Tutorial volume on Maude was published in 2007, with significant contributions to this volume made by Dr. Talcott. She has also been an important contributor to many of the new releases of the Maude software; such releases are regularly made as new features are incorporated. The field of rewriting logic is now firmly established with regular scientific conferences as well as hundreds of peer-reviewed publications in the area.

Dr. Talcott's move to SRI has been fruitful for the area of computational biology: at SRI, she has led a remarkably productive collaboration between molecular biologists and computer scientists. Specifically, Dr. Talcott has played a key leadership role in advancing this entire field by the application of formal methods to systems biology. She has initiated the Pathway Logic Project which has made many contributions, not only conceptual ones, but also by developing practical tools that biologists find easy to understand and use; these tools enable visualization and efficient formal analysis of biological systems.

Over the years, Dr. Talcott has collaborated with a large number of researchers across the globe, among them the editors of this volume. Not surprisingly, some of the papers we were able to include in this volume have their genesis in such collaborations. Her impact, beyond her technical contributions, includes the scores of researchers in the computer science community whom she has inspired over the years.

It is our good fortune to be able to organize this Festschrift in honor of Dr. Carolyn Talcott and we look forward to many more years of her leadership as an innovative researcher, valued colleague and inspiring mentor.

August 2011

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Table of Contents

Publications of Dr. Carolyn Talcott

(Note - some publications as C.T. Williamson)

[1] Abate, A., Bai, Y., Sznajder, N., Talcott, C., Tiwari, A.: Quantitative and probabilistic modeling in Pathway Logic. In: IEEE 7th International Symposium on Bioinformatics and Bioengineering, pp. 922–929. IEEE (2007)

[2] Agha, G., Mason, I.A., Smith, S.F., Talcott, C.L.: Towards a theory of actor computation. In: Cleaveland, W.R. (ed.) CONCUR 1992. LNCS, vol. 630, pp. 565–579. Springer, Heidelberg (1992)

[3] Agha, G., Mason, I.A., Smith, S.F., Talcott, C.L.: A foundation for actor computation. Journal of Functional Programming 7, 1–72 (1997)

[4] Amaral, A.M.S.C., Linnett, J.W., Williamson, C.T.: The double bond in ethylene. Theoretical Chimica Acta 16, 249–262 (1970)

[5] Arbab, F., Talcott, C. (eds.): COORDINATION 2002. LNCS, vol. 2315. Springer, Heidelberg (2002)

[6] Bronstein, A., Talcott, C.L.: Formal verification of pipelines based on string-functional semantics. In: IFIP International Workshop on Applied Formal Methods for Correct VLSI Design, Leuven, Belgium (1989)

[7] Bronstein, A., Talcott, C.L.: Formal verification of synchronous circuits based on string-functional semantics: The 7 paillet circuits in boyer-moore. In: Sifakis, J. (ed.) CAV 1989. LNCS, vol. 407, pp. 317–333. Springer, Heidelberg (1990)

[8] Burgoyne, N., Williamson, C.: Some computations involving simple lie algebras. In: Proceedings of the Second ACM Symposium on Symbolic and Algebraic Manipulation, pp. 162–171 (1971)

[9] Burgoyne, N., Williamson, C.: Semi-simple classes in chevalley type groups. Pacific Journal of Mathematics 70, 83–100 (1977)

[10] Clavel, M., Durán, F., Eker, S., Lincoln, P., Marti-Oliet, N., Meseguer, J., Talcott, C.: Maude 2.0 Manual (2003), `http://maude.cs.uiuc.edu`

[11] Clavel, M., Durán, F., Eker, S., Lincoln, P., Martí-Oliet, N., Meseguer, J., Talcott, C.L.: The Maude 2.0 system. In: Nieuwenhuis, R. (ed.) RTA 2003. LNCS, vol. 2706, pp. 76–87. Springer, Heidelberg (2003)

[12] Clavel, M., Durán, F., Eker, S., Escobar, S., Lincoln, P., Martí-Oliet, N., Meseguer, J., Talcott, C.: Unification and narrowing in maude 2.4. In: Treinen, R. (ed.) RTA 2009. LNCS, vol. 5595, pp. 380–390. Springer, Heidelberg (2009)

[13] Clavel, M., Durán, F., Eker, S., Lincoln, P., Martí-Oliet, N., Meseguer, J., Talcott, C.: All About Maude - A High-Performance Logical Framework. How to Specify, Program and Verify Systems in Rewriting Logic. LNCS, vol. 4350. Springer, Heidelberg (2007)

[14] Coglio, A., Giunchiglia, F., Meseguer, J., Talcott, C.L.: Composing and Controlling Deduction in Reasoning Theories Using Mappings. In: Kirchner, H. (ed.) FroCos 2000. LNCS, vol. 1794, pp. 200–216. Springer, Heidelberg (2000)

[15] Coglio, A., Giunchiglia, F., Pecchiari, P., Talcott, C.L.: A logic level specification of the NQTHM simplification process. Technical report, IRST, University of Genova, Stanford University (1997)

[16] Denker, G., García-Luna-Aceves, J.J., Meseguer, J., Ölveczky, P.C., Raju, J., Smith, B., Talcott, C.L.: Specifications and analysis of a reliable broadcasting protocol in Maude. In: Hajek, B., Sreenivas, R.S. (eds.) 37th Allerton Conference on Communication, Control, and Computing, pp. 738–747 (1999) Case study details, `http://maude.csl.sri.com/casestudies/rbp/`

[17] Denker, G., Meseguer, J., Talcott, C.L.: Protocol specification and analysis in Maude. In: Workshop on Formal Methods and Security Protocols (June 1998), http://www.cs.bell-labs.com/who/nch/fmsp/index.html

[18] Denker, G., Meseguer, J., Talcott, C.L.: Rewriting Semantics of Distributed Meta Objects and Composable Communication Services (1999) (submitted)

[19] Denker, G., Meseguer, J., Talcott, C.L.: Formal specification and analysis of active networks and communication protocols: The Maude experience. In: DARPA Information Survivability Conference and Exposition (DISCEX 2000), vol. 1, pp. 251–265. IEEE (2000)

[20] Denker, G., Meseguer, J., Talcott, C.L.: Rewriting semantics of distributed meta objects and composable communication services. In: Third International Workshop on Rewriting Logic and Its Applications (WRLA 2000), Kanazawa, Japan, September 18-20. Electronic Notes in Theoretical Computer Science, vol. 36. Elsevier (2000), http://www.elsevier.nl/locate/entcs/volume36.html

[21] Denker, G., Talcott, C.L.: Formal checklists for remote agent dependability. In: Fifth International Workshop on Rewriting Logic and Its Applications (WRLA 2004). Electronic Notes in Theoretical Computer Science. Elsevier (2004)

[22] Denker, G., Talcott, C.L.: A formal framework for goal net analysis. In: Workshop on Verification and Validation of Planning Systems. AAAI (2005)

[23] Denker, G., Talcott, C., Ghanadan, R., Kumar, S.: An architecture for policy-based cognitive tactical networking. In: Military Communications Conference, MILCOM (2006)

[24] di Blasio, P., Fisher, K., Talcott, C.: A control-flow analysis for a calculus of concurrent objects. Transactions in Software Engineering, TSE (2000)

[25] di Blasio, P., Fisher, K., Talcott, C.L.: A control-flow analysis for a calculus of concurrent objects. In: Bowman, H., Derrick, J. (eds.) Formal Methods for Open Object-based Distributed Systems, vol. 2, pp. 73–88. Chapman & Hall (1997)

[26] Dill, D.L., Knapp, M.A., Gage, P., Talcott, C., Lincoln, P., Laderoute, K.: The pathalyzer: A tool for analysis of signal transduction pathways. In: Eskin, E., Ideker, T., Raphael, B., Workman, C. (eds.) RECOMB 2005. LNCS (LNBI), vol. 4023, pp. 11–22. Springer, Heidelberg (2007)

[27] Donaldson, R., Talcott, C., Knapp, M., Calder, M.: Understanding signalling networks as collections of signal transduction pathways. In: Computational Methods in Systems Biology (2010)

[28] Duarte, C.H.C., Talcott, C.L.: Clara: An actor language for high performance distributed computing. In: Proc. Brazilian Symposium on Computer Architecture – High Performance Computing (SBAC-PAD 2000), Sao Pedro, SP, Brazil (2000)

[29] Duran, F., Eker, S., Escobar, S., Meseguer, J., Talcott, C.: Variants, unification, narrowing, and symbolic reachability in maude 2.6. In: Rewriting Techniques and Applications (2011)

[30] Eker, S., Laderoute, K., Lincoln, P., Sriram, M.G., Talcott, C.: Representing and simulating protein functional domains in signal transduction using MAUDE. In: Priami, C. (ed.) CMSB 2003. LNCS, vol. 2602, pp. 164–165. Springer, Heidelberg (2003)

[31] Eker, S., Knapp, M., Laderoute, K., Lincoln, P., Talcott, C.: Pathway Logic: Executable models of biological networks. In: Fourth International Workshop on Rewriting Logic and Its Applications (WRLA 2002), Pisa, Italy, September 19-21. Electronic Notes in Theoretical Computer Science, vol. 71, Elsevier (2002), http://www.elsevier.nl/locate/entcs/volume71.html

[32] Ekins, S., Freundlich, J.S., Choi, I., Sarker, M., Talcott, C.: Computational databases, pathway and cheminformatics tools for tuberculosis drug discovery. Trends in Microbiology 19(2) (February 2011)

[33] Galbiati, L., Talcott, C.L.: A Simplifier for Untyped Lambda Expressions. In: Okada, M., Kaplan, S. (eds.) CTRS 1990. LNCS, vol. 516, pp. 342–353. Springer, Heidelberg (1991)

[34] Galbiati, L., Talcott, C.L.: A simplifier for untyped lambda expressions. Technical Report STAN-CS-90-1337, Computer Science Department, Stanford University (1990)

[35] Giunchiglia, F., Pecchiari, P., Talcott, C.L.: Reasoning theories: Towards an architecture for open mechanized reasoning systems. Technical Report 9409-15, IRST, Also appears as Stanford University Computer Science Department Technical Note STAN-CS-94-TN-15 (November 1994)

[36] Giunchiglia, F., Pecchiari, P., Talcott, C.L.: Reasoning theories: Towards an architecture for open mechanized reasoning systems. In: Workshop on Frontiers of Combining Systems FROCOS 1996 (1996)

[37] Giunchiglia, F., Pecchiari, P., Talcott, C.L.: Reasoning theories: Towards an architecture for open mechanized reasoning systems (1996) (submitted for publication)

[38] Higher Order Operational Techniques in Semantics II, Electronic Notes in Theoretical Computer Science. Elsevier (1998), `http://www.elsevier.nl/locate/entcs/volume10.html`

[39] Greco, M.A., Murray, J., Talcott, C.: Modeling sleep-related activities from experimental observations - initial computational frameworks for understanding sleep function(s). In: AHFE. Taylor and Francis, LLC (2010)

[40] Gutierrez-Nolasco, S., Venkatasubramanian, N., Stehr, M.-O., Talcott, C.L.: Towards adaptive secure group communication: Bridging the gap between formal specification and network simulation. In: 12th IEEE Pacific Rim International Symposium on Dependable Computing (PRDC 2006), pp. 113–120. IEEE Computer Society (2006)

[41] Gutierrez-Nolasco, S., Venkatasubramanian, N., Talcott, C., Stehr, M.-O.: Tailoring group membership consistency for mobile networks. In: CTS (2011)

[42] Heiser, L.M., Wang, N.J., Talcott, C.L., Laderoute, K.R., Knapp, M., Guan, Y., Hu, Z., Ziyad, S., Weber, B.L., Laquerre, S., Jackson, J.R., Wooster, R.F., Kuo, W.-L., Gray, J.W., Spellman, P.T.: Integrated analysis of breast cancer cell lines reveals unique signaling pathways. Genome Biology 10, R31 (2009)

[43] Honsell, F., Mason, I.A., Smith, S.F., Talcott, C.L.: A theory of classes for a functional language with effects. In: Martini, S., Börger, E., Kleine Büning, H., Jäger, G., Richter, M.M. (eds.) CSL 1992. LNCS, vol. 702, pp. 309–326. Springer, Heidelberg (1993)

[44] Honsell, F., Mason, I.A., Smith, S.F., Talcott, C.L.: A variable typed logic of effects. Information and Computation 119(1), 55–90 (1995)

[45] Iida, S., Denker, G., Talcott, C.: Document logic: Risk analysis of business processes through document authenticity. In: DDBP. IEEE Digital Library (2009)

[46] Iida, S., Denker, G., Talcott, C.: Document logic: Risk analysis of business processes through document authenticity. Journal of Research and Practice in Information Technology (2011)

[47] Iyengar, S.M., Talcott, C., Mozzachiodi, R., Cataldo, E., Baxter, D.A.: Executable symbolic models of neural processes. In: Network Tools and Applications in Biology, NETTAB 2007 (2007)

[48] Jones, N., Talcott, C. (eds.): Proceedings of The Atlantique Workshop on Semantics Based Program Manipulation, University of Copenhagen DIKU Technical Report 94/12 (1994)
[49] Katz, T.J., Talcott, C.L.: The cyclononatetraene anion radical. Journal of the Amermican Chemical Society 88, 4732 (1966)
[50] Khakpour, N., Jalili, S., Talcott, C., Sirjani, M., Mousavi, M.R.: Pobsam: Policy-based managing of actors in self-adaptive systems. In: Formal Aspects of Component Software (FACS). Electronic Notes in Theoretical Computer Science (2009)
[51] Kim, M., Stehr, M.-O., Talcott, C.: A distributed logic for networked cyber-physical systems. In: Foundations of Software Engineering. LNCS. Springer, Heidelberg (2011)
[52] Kim, M., Stehr, M.-O., Talcott, C., Dutt, N., Venkatasubramanian, N.: Combining formal verification with observed system execution behavior to tune system parameters. In: Formal Methods for Open Object-based Distributed Systems. Springer, Heidelberg (2007)
[53] Kim, M.-Y., Stehr, M.-O., Talcott, C., Dutt, N., Venkatasubramanian, N.: A probabilistic formal analysis approach to cross layer optimization in distributed embedded systems. In: Bonsangue, M.M., Johnsen, E.B. (eds.) FMOODS 2007. LNCS, vol. 4468, pp. 285–300. Springer, Heidelberg (2007)
[54] Kim, M., Stehr, M.-O., Talcott, C., Dutt, N., Venkatasubramanian, N.: Constraint refinement for online verifiable cross-layer system adaptation. In: IEEE/ACM Design Automation and Test in Europe (DATE 2008). IEEE/ACM (2008)
[55] Kim, M., Stehr, M.-O., Talcott, C., Dutt, N., Venkatasubramanian, N.: xtune: A formal methodology for cross-layer tuning of mobile embedded systems. Transactions on Embedded Computing Systems (2011)
[56] Lincoln, P.D., Talcott, C.: Symbolic systems biology and pathway logic. In: Iyengar, S. (ed.) Symbolic Systems Biology. Jones and Bartlett (2010)
[57] Mason, I.A., Pehoushek, J.D., Talcott, C.L., Weening, J.S.: A Qlisp Primer. Technical Report STAN-CS-90-1340, Department of Computer Science, Stanford University (1990)
[58] Mason, I.A., Smith, S.F., Talcott, C.L.: From Operational Semantics to Domain Theory. Information and Computation 128(1), 26–47 (1996)
[59] Mason, I.A., Talcott, C.L.: Memories of S-expressions: Proving properties of Lisp-like programs that destructively alter memory. Technical Report STAN-CS-85-1057, Department of Computer Science, Stanford University (1985)
[60] Mason, I.A., Talcott, C.L.: Axiomatizing operational equivalence in the presence of side effects. In: Fourth Annual Symposium on Logic in Computer Science. IEEE (1989)
[61] Mason, I.A., Talcott, C.L.: Programming, transforming, and proving with function abstractions and memories. In: Ronchi Della Rocca, S., Ausiello, G., Dezani-Ciancaglini, M. (eds.) ICALP 1989. LNCS, vol. 372, pp. 574–588. Springer, Heidelberg (1989)
[62] Mason, I.A., Talcott, C.L.: A sound and complete axiomatization of operational equivalence between programs with memory. Technical Report STAN-CS-89-1250, Department of Computer Science, Stanford University (1989)
[63] Mason, I.A., Talcott, C.L.: Program transformation for configuring components (1990)
[64] Mason, I.A., Talcott, C.L.: Reasoning about programs with effects. In: Deransart, P., Małuszyński, J. (eds.) PLILP 1990. LNCS, vol. 456, pp. 189–203. Springer, Heidelberg (1990)

[65] Mason, I.A., Talcott, C.L.: Equivalence in functional languages with effects. Journal of Functional Programming 1, 287–327 (1991)

[66] Mason, I.A., Talcott, C.L.: Program transformation for configuring components. In: ACM/IFIP Symposium on Partial Evaluation and Semantics-based Program Manipulation (1991)

[67] Mason, I.A., Talcott, C.L.: Program transformation via constraint propagation (1991)

[68] Mason, I.A., Talcott, C.L.: Inferring the equivalence of functional programs that mutate data. Theoretical Computer Science 105(2), 167–215 (1992)

[69] Mason, I.A., Talcott, C.L.: References, local variables and operational reasoning. In: Seventh Annual Symposium on Logic in Computer Science, pp. 186–197. IEEE (1992)

[70] Mason, I.A., Talcott, C.L.: Program transformation via contextual assertions. In: Jones, N.D., Hagiya, M., Sato, M. (eds.) Logic, Language and Computation. LNCS, vol. 792, pp. 225–254. Springer, Heidelberg (1994)

[71] Mason, I.A., Talcott, C.L.: Reasoning about object systems in VTLoE. International Journal of Foundations of Computer Science 6(3), 265–298 (1995)

[72] Mason, I.A., Talcott, C.L.: A semantically sound actor translation. In: Degano, P., Gorrieri, R., Marchetti-Spaccamela, A. (eds.) ICALP 1997. LNCS, vol. 1256, pp. 369–378. Springer, Heidelberg (1997)

[73] Mason, I.A., Talcott, C.L.: Landin-feferman logic. In: The Fourteenth Workshop on the Mathematical Foundations of Programming Semantics, MFPS 14 (1998)

[74] Mason, I.A., Talcott, C.L.: Actor languages: Their syntax, semantics, translation, and equivalence. Theoretical Computer Science 220, 409–467 (1999)

[75] Mason, I.A., Talcott, C.L.: Simple network protocol simulation within Maude. In: Third International Workshop on Rewriting Logic and Its Applications (WRLA 2000), Kanazawa, Japan, September 18-20. Electronic Notes in Theoretical Computer Science, vol. 36. Elsevier (2000), `http://www.elsevier.nl/locate/entcs/volume36.html`

[76] Mason, I.A., Talcott, C.L.: Feferman–Landin Logic. In: Sieg, W., Sommer, R., Talcott, C.L. (eds.) Reflections on the Foundations of Mathematics: Essays in Honor of Solomon Feferman. Lecture Notes in Logic, pp. 299–344. Association of Symbolic Logic (2002)

[77] Mason, I.A., Talcott, C.L.: IOP: The InterOperability Platform & IMaude: An interactive extension of Maude. In: Fifth International Workshop on Rewriting Logic and Its Applications (WRLA 2004). Electronic Notes in Theoretical Computer Science. Elsevier (2004)

[78] Mason, I.A., Talcott, C.: Actors and logical analysis of interactive system. In: Viroli, M. (ed.) Foundations of Interactive Computation (FInCo 2005). Electronic Notes in Theoretical Computer Science, vol. 141. Elsevier (2005)

[79] Maurer, W.D., Williamson, C.T.: Algorithm verification applied to the todd-coxeter algorithm. Technical Report ERL-M317, Electronics Research Lab., College of Engineering, U.C. Berkeley (1971)

[80] Meseguer, J., Olveczky, P.C., Stehr, M.-O., Talcott, C.L.: Maude as a wide-spectrum framework for formal modeling and analysis of active networks. In: DARPA Active Networks Conference and Exposition (DANCE), pp. 494–510. IEEE (May 2002)

[81] Meseguer, J., Talcott, C.L.: Rewriting logic and secure mobility. In: NPS Workshop on Active Networks, Monterey, CA (February 1997)

[82] Meseguer, J., Talcott, C.L.: Formal foundations for compositional software architectures. Position paper for Workshop on Compositional Software Architectures, Monterey, CA (January 1998)

[83] Meseguer, J., Talcott, C.L.: Mapping OMRS to Rewriting Logic. In: Kirchner, C., Kirchner, H. (eds.) 2nd International Workshop on Rewriting Logic and Its Applications, WRLA 1998. Electronic Notes in Theoretical Computer Science, vol. 15. Elsevier (1998), `http://www.elsevier.nl/locate/entcs/volume15.html`

[84] Bevilacqua, V., Talcott, C.: A Partial Order Event Model for Concurrent Objects. In: Baeten, J.C.M., Mauw, S. (eds.) CONCUR 1999. LNCS, vol. 1664, pp. 415–430. Springer, Heidelberg (1999)

[85] Meseguer, J., Talcott, C.L.: Semantic models for distributed object reflection. In: Deng, T. (ed.) ECOOP 2002. LNCS, vol. 2374, pp. 1–36. Springer, Heidelberg (2002)

[86] Meyers, R.J., Talcott, C.L.: Electron spin resonance of the radical anions of pyridine and related nitrogen heterocyclics. Molecular Physics 12, 549–567 (1967)

[87] Montanari, U., Talcott, C.L.: Can actors and π-agents live together? In: Higher Order Operational Techniques in Semantics II. Electronic Notes in Theoretical Computer Science. Elsevier (1997), `http://www.elsevier.nl/locate/entcs/volume10.html`

[88] Nagayama, M., Talcott, C.: An nqthm mechanization of "an exercise in the verification of multi-process programs". Technical Report STAN-CS-91-1370, Computer Science Department, Stanford University (1991)

[89] Ölveczky, P.C., Keaton, M., Meseguer, J., Talcott, C., Zabele, S.: Specification and analysis of the AER/NCA active network protocol suite in real-time maude. In: Hussmann, H. (ed.) FASE 2001. LNCS, vol. 2029, pp. 333–347. Springer, Heidelberg (2001), `http://maude.csl.sri.com/papers`

[90] Ölveczky, P.C., Meseguer, J., Talcott, C.: Specification and analysis of the AER/NCA active network protocol suite in Real-Time Maude. In: Formal Methods in System Design (2006)

[91] Pagliarecci, F., Spalazzi, L., Stehr, M.-O., Talcott, C.: Formal specification of agent-object oriented programs. In: Symposium on Collaborative Technologies and Systems (2008)

[92] Santiago, S., Talcott, C., Escobar, S., Meadows, C., Meseguer, J.: A graphical user interface for Maude-NPA. In: Spanish Conference on Programming and Computer Languages (PROLE). ENTCS (2009)

[93] Sarker, M., Chopra, S., Mortelmans, K., Kodukula, K., Talcott, C., Galande, A.K.: Systems level in silico pathway analysis predicts metabolites that are potential antimicrobial targets. Journal of Computer Science and Systems Biology (accepted, April 2011)

[94] Shmatikov, V., Talcott, C.: Reputation-based trust management. In: 2003 IFIP WG 1.7, ACM SIGPLAN and GI FoMSESS Workshop on Issues in the Theory of Security, WITS 2003 (2003)

[95] Shmatikov, V., Talcott, C.: Reputation-based trust management. Journal of Computer Security (2004)

[96] Sieg, W., Sommer, R., Talcott, C. (eds.): Reflections on the Foundations of Mathematics: Essays in honor of Solomon Feferman. Lecture Notes in Logic, vol. 15. Association for Symbolic Logic (2002)

[97] Sieg, W., Sommer, R., Talcott, C. (eds.): Reflections on the Foundations of Mathematics: Essays in Honor of Solomon Feferman. LNL, vol. 15. Association for Symbolic Logic (2002)

[98] Smith, S.F., Talcott, C.L.: Modular reasoning for actor specification diagrams. In: Ciancariani, P., Fantechi, A., Gorrieri, R. (eds.) Formal Methods for Open Object-based Distributed Systems, pp. 313–330. Kluwer (1999)
[99] Smith, S.F., Talcott, C.L. (eds.): Formal Methods for Open Object-based Distributed Systems, vol. 4. Kluwer (2000)
[100] Smith, S.F., Talcott, C.L.: Specification diagrams for actor systems. Higer-Order and Symbolic Computation 15(4), 301–348 (2002)
[101] Stehr, M.-O., Kim, M., Talcott, C.: Toward distributed declarative control of networked cyber-physical systems. In: Yu, Z., Liscano, R., Chen, G., Zhang, D., Zhou, X. (eds.) UIC 2010. LNCS, vol. 6406, pp. 397–413. Springer, Heidelberg (2010)
[102] Stehr, M.-O., Talcott, C.: PLAN in Maude: Specifying an active network programming language. In: Fourth International Workshop on Rewriting Logic and Its Applications (WRLA 2002), Pisa, Italy, September 19-21. Electronic Notes in Theoretical Computer Science, vol. 71, Elsevier (2002), `http://www.elsevier.nl/locate/entcs/volume71.html`
[103] Stehr, M.-O., Talcott, C.: Practical techniques for language design and prototyping. In: Farwer, B., Moldt, D. (eds.) Object Petri Nets, Processes, and Object Calculi, University of Hamburg (2005), Technical Report FBI-HH-B-265/05
[104] Stehr, M.-O., Talcott, C.: Planning and learning algorithms for routing in disruption-tolerant networks. In: MILCOM 2008. IEEE (2008)
[105] Talcott, C., Eker, S., Knapp, M., Lincoln, P., Laderoute, K.: Pathway logic modeling of protein functional domains in signal transduction. In: Proceedings of the Pacific Symposium on Biocomputing (January 2004)
[106] Talcott, C.L.: The essence of Rum: A theory of the intensional and extensional aspects of Lisp-type computation. PhD thesis, Stanford University (1985)
[107] Talcott, C.L.: Rum: An intensional theory of function and control abstractions. In: Foundations of Logic and Functional Programming. LNCS, vol. 306, pp. 1–44. Springer, Heidelberg (1986)
[108] Talcott, C.L.: Algebraic methods in programming language theory. In: First International Conference on Algebraic Methodology and Software Technology, Iowa City, Iowa, AMAST 1989 (1989)
[109] Talcott, C.L.: Programming and proving with function and control abstractions. Technical Report STAN-CS-89-1288, Stanford University Computer Science Department (1989)
[110] Talcott, C.L.: Binding structures. In: Lifschitz, V. (ed.) Artificial Intelligence and Mathematical Theory of Computation. Academic Press (1991)
[111] Talcott, C.L.: Towards a framework for specifying components of automated reasoning systems: A report on work in progress. In: TTCP XTP-1 Workshop on Effective Use of Automated Reasoning Technology in System Development, EUARTSD (1992)
[112] Talcott, C.L.: Sketch of an architecture for reasoning systems (1993)
[113] Talcott, C.L.: A theory for program and data specification. Theoretical Computer Science 104, 129–159 (1993)
[114] Talcott, C.L.: A theory of binding structures and its applications to rewriting. Theoretical Computer Science 112, 99–143 (1993)
[115] Talcott, C.L.: Mathematical foundations for survivable systems. In: Proceedings of IMACS 1994 Workshop on New Mathematics for Computer Science (1994)
[116] Talcott, C.L.: Reasoning specialists should be logical services, not black boxes. In: Proceedings of CADE-12 workshop on Theory Reasoning in Automated Deduction, pp. 1–6 (1994)

[117] Talcott, C.L.: Reasoning about programs. Notes from Invited Talk for the Dagstuhl Workshop on New Trends in Integration of Paradigms and Coordination. Dagstuhl, Germany (September 1995)

[118] Talcott, C.L.: An actor rewriting theory. In: Meseguer, J. (ed.) Proc. 1st Intl. Workshop on Rewriting Logic and Its Applications. Electronic Notes in Theoretical Computer Science, vol. 4, pp. 360–383. Elsevier (1996), http://www.elsevier.nl/locate/entcs/volume4.html

[119] Talcott, C.L.: Interaction semantics for components of distributed systems. In: Najm, E., Stefani, J.-B. (eds.) 1st IFIP Workshop on Formal Methods for Open Object-based Distributed Systems, FMOODS 1996 (1996); Proceedings published in 1997 by Chapman & Hall

[120] Talcott, C.L.: Reasoning about functions with effects. In: Higher Order Operational Techniques in Semantics. Cambridge University Press (1996)

[121] Talcott, C.L.: Reflection in actor systems. Paper presented at the Workshop on New Mathematics for Computer Science – Computational Models and Semantics Session (October 1996)

[122] Talcott, C.L.: Composable semantic models for actor theories. In: Abadi, M., Ito, T. (eds.) TACS 1997. LNCS, vol. 1281, pp. 321–364. Springer, Heidelberg (1997)

[123] Talcott, C.L.: Interaction Semantics for Components of Distributed Systems. In: Najm, E., Stefani, J.-B. (eds.) Formal Methods for Open Object-based Distributed Systems, pp. 154–169. Chapman & Hall (1997)

[124] Talcott, C.L.: Composable semantic models for actor theories. Higher-Order and Symbolic Computation 11(3), 281–343 (1998)

[125] Talcott, C.L.: Reasoning about programs with effects. In: 2nd NSF-CNPq Workshop on Semantics. Electronic Notes in Theoretical Computer Science. Elsevier (1998)

[126] Talcott, C.L.: Towards a toolkit for actor system specification. In: Rus, T. (ed.) AMAST 2000. LNCS, vol. 1816, pp. 391–406. Springer, Heidelberg (2000)

[127] Talcott, C.L.: Actor theories in rewriting logic. Theoretical Computer Science 285(2) (2002)

[128] Talcott, C.L., Weyhrauch, R.W.: Partial evaluation, higher–order abstractions, and reflection principles as system building tools. In: Bjorner, D., Erschov, A.P. (eds.) IFIP TC2 Working Conference on Partial and Mixed Computation, Ebberup, Denmark. North-Holland (1987)

[129] Talcott, C.L., Weyhrauch, R.W.: Towards a theory of mechanized reasoning I: FOL contexts, an extensional view. In: Proc. of the 8th European Conference on Artificial Intelligence (ECAI 1990), pp. 634–639 (1990)

[130] Talcott, C.: Electron Spin Resonance Studies of Radicals Produced by Electrolysis. PhD thesis, University of California, Berkeley (1967)

[131] Talcott, C.: Coordination models based on a formal model of distributed object reflection. In: 1st International Workshop on Methods and Tools for Coordinating Concurrent, Distributed and Mobile Systems, MTCoord 2005 (2005)

[132] Talcott, C.: Formal executable models of cell signaling primitives. In: Margaria, T., Philippou, A., Steffen, B. (eds.) 2nd International Symposium On Leveraging Applications of Formal Methods, Verification and Validation ISOLA 2006, pp. 303–307 (2006)

[133] Talcott, C.: Policy-based coordination in pagoda: A case study. In: 2nd International Workshop on Methods and Tools for Coordinating Concurrent, Distributed and Mobile Systems (MTCoord 2006). ENTCS, vol. 181(7) (2006)

[134] Talcott, C.: Symbolic modeling of signal transduction in pathway logic. In: Perrone, L.F., Wieland, F.P., Liu, J., Lawson, B.G., Nicol, D.M., Fujimoto, R.M. (eds.) 2006 Winter Simulation Conference, pp. 1656–1665 (2006)
[135] Talcott, C.: A formal framework for interactive agents. In: Arbab, F., Golden, D. (eds.) Foundations of Interactive Computation (FInCo 2007). Electronic Notes in Theoretical Computer Science, vol. 203, pp. 95–106. Elsevier (2007)
[136] Talcott, C.: Pathway logic. In: Bernardo, M., Degano, P., Zavattaro, G. (eds.) SFM 2008. LNCS, vol. 5016, pp. 21–53. Springer, Heidelberg (2008)
[137] Talcott, C., Dill, D.L.: The pathway logic assistant. In: Plotkin, G. (ed.) Third International Workshop on Computational Methods in Systems Biology, pp. 228–239 (2005)
[138] Talcott, C., Dill, D.L.: Multiple representations of biological processes. In: Priami, C., Plotkin, G. (eds.) Transactions on Computational Systems Biology VI. LNCS (LNBI), vol. 4220, pp. 221–245. Springer, Heidelberg (2006)
[139] Talcott, C., Lincoln, P.: Towards a semantic framework for secure agents: Extended abstract. In: High Confidence Software and Sytems, HCSS 2003 (April 2003)
[140] Talcott, C., Sirjani, M., Ren, S.: Comparing three coordination models: Reo, arc, and rrd. In: Formal Methods for Open Object-based Distributed Systems. Springer, Heidelberg (2007)
[141] Talcott, C., Sirjani, M., Ren, S.: Comparing three coordination models: Reo, arc, and rrd. Science of Computer Programming (2009)
[142] Tiwari, A., Talcott, C.: Analyzing a discrete model of aplysia central pattern generator. In: Heiner, M., Uhrmacher, A. (eds.) CMSB 2008. LNCS (LNBI), vol. 5307, pp. 347–366. Springer, Heidelberg (2008)
[143] Tiwari, A., Talcott, C., Knapp, M., Lincoln, P., Laderoute, K.: Analyzing pathways using SAT-based approaches. In: Anai, H., Horimoto, K., Kutsia, T. (eds.) Ab 2007. LNCS, vol. 4545, pp. 155–169. Springer, Heidelberg (2007)
[144] Venkatasubramanian, N., Agha, G., Talcott, C.L.: Scalable distributed garbage collection for systems of active objects. In: Bekkers, Y., Cohen, J. (eds.) IWMM-GIAE 1992. LNCS, vol. 637, pp. 134–147. Springer, Heidelberg (1992)
[145] Venkatasubramanian, N., Agha, G., Talcott, C.L.: Composable QoS-based distributed resource management. Position paper for Workshop on Compositional Software Architectures, Monterey, CA (January 1998)
[146] Venkatasubramanian, N., Agha, G., Talcott, C.L.: A metaobject framework for qos-based distributed resource management. In: Third International Symposium on Computing in Object-Oriented Parallel Environments, ISCOPE 1999 (1999)
[147] Venkatasubramanian, N., Agha, G., Talcott, C.: A formal model for reasoning about adaptive QoS-enabled middleware. In: Oliveira, J.N., Zave, P. (eds.) FME 2001. LNCS, vol. 2021, pp. 197–221. Springer, Heidelberg (2001)
[148] Venkatasubramanian, N., Agha, G., Talcott, C.L.: Formal reasoning for QoS-enabled middleware. ACM Transactions on Software Engineering and Methodology (2004) (accepted for publication)
[149] Venkatasubramanian, N., Talcott, C.L.: A metaarchitecture for distributed resource management. In: Hawaii International Conference on System Sciences, HICSS-26 (January 1993)
[150] Venkatasubramanian, N., Talcott, C.L.: Reasoning about meta level activities in open distributed systems. In: Principles of Distributed Computation (PODC 1995), pp. 144–153. ACM (1995)

[151] Venkatasubramanian, N., Talcott, C.L.: A reflective framework for providing safe qos-enabled customizable middleware. In: Workshop on Reflective Middleware, RM 2000 (2000)

[152] Venkatasubramanian, N., Talcott, C.L.: A semantic framework for modeling and reasoning about reflective middleware (2001)

[153] Wang, A., Talcott, C., Jia, L., Loo, B.T., Scedrov, A.: Analyzing BGP instances in maude. In: Bruni, R., Dingel, J. (eds.) FORTE 2011 and FMOODS 2011. LNCS, vol. 6722, pp. 334–348. Springer, Heidelberg (2011)

[154] Weyhrauch, R.W., Cadoli, M., Talcott, C.L.: Using abstract resources to control reasoning. Journal of Logic Language and Information 7, 77–101 (1998)

[155] Weyhrauch, R.W., Talcott, C.L.: The logic of FOL systems: Formulated in set theory. In: Hagiya, M., Jones, N.D., Sato, M. (eds.) Logic, Language and Computation. LNCS, vol. 792, pp. 119–132. Springer, Heidelberg (1994)

[156] Wilkins, D., Denker, G., Stehr, M.-O., Elenius, D., Senanayake, R., Talcott, C.: Coral - policy language and reasoning techniques for spectrum policies. In: Policy 2007 (2007)

[157] Wilkins, D., Denker, G., Stehr, M.-O., Elenius, D., Senanayake, R., Talcott, C.: Policy-based cognitive radios. IEEE Wireless Communications (2007); Special Issue on Cognitive Wireless Networks (to appear)

[158] Wirsing, M., Denker, G., Talcott, C., Poggio, A., Briesemeister, L.: A rewriting logic framework for soft constraints. In: Sixth International Workshop on Rewriting Logic and Its Applications (WRLA 2006). Electronic Notes in Theoretical Computer Science. Elsevier (2006)

[159] Yu, Y., Ren, S., Talcott, C.: Coordinating asynchronous and open distributed systems under semiring-based timing constraints. In: Canal, C., Poizat, P., Sirjani, M. (eds.) Foundations of Coordination Languages and Software Architectures FOCLASA 2008 (2008)