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Curriculum vitæ

Employment

- **2007 - 2008: Post-Doctoral position** at INRIA Grenoble - Rhône-Alpes
With: Bruno GAUJAL and Jean-Marc VINCENT
- **2006 - 2007: Attaché Temporaire d'Enseignement et de la Recherche** (one year research/teaching faculty position), Université de Versailles Saint-Quentin

Education

- **2003 - 2007: PhD in Computer Science** at PRiSM, Université de Versailles Saint-Quentin

Thesis title: Stochastic comparison of Markov models: an algorithmic approach and its applications in reliability and performance evaluation

Full text (in French) can be found at:
<http://www.prism.uvsq.fr/~abusic/thesis.html>

Advisor: Prof. Jean-Michel FOURNEAU

Defended: 16 July 2007.

Thesis committee: Alain Jean-Marie (INRIA Sophia-Antipolis and Université Montpellier 2; referee), Gerardo Rubino (INRIA/IRISA Rennes; referee), Dominique Barth (Université de Versailles Saint-Quentin), Jean-Michel Fourneau (Université de Versailles Saint-Quentin; advisor), Bruno Gaujal (INRIA Grenoble - Rhône-Alpes), Jean Mairesse (Paris 7), Nihal Pekergin (Paris 1)
- **2002 - 2003: DEA Mathématiques – Informatique** (Master degree), Université de Versailles St-Quentin

Master degree thesis: Qualitative simulation of metabolic networks

Advisor: Prof. Jean-Michel FOURNEAU
- **1996 - 2002: B.S. in Mathematics**, Department of mathematics, University of Zagreb, Croatia

Option: mathematical statistics and computer science

Final project thesis: Analysis of daily temperatures in Zagreb using SARIMA models (time series)

Department of mathematics and in cooperation with Department of geophysics, University of Zagreb, Croatia

Advisor: Prof. Zoran VONDRÁČEK

Research visits

- **20-26 January 2008:** Technische Universiteit Eindhoven and EURANDOM
- **August - September 2007:** Carnegie Mellon University

Research summary

Markov processes are largely used in various domains due to their simplicity to model real systems. Many high-level formalisms have been developed in order to simplify the definition and generation of these models. However, the growing complexity of studied systems results in state-space explosion of Markovian models and the classical analytical or numerical methods do not apply. Stochastic comparison techniques allow to construct simpler models that are easier to solve and that can provide bounds for a given measure of interest. I am particularly interested in algorithmic aspects of these techniques and their applications to reliability and performance evaluation. Most of the former results on the algorithmic construction of bounding models uses strong stochastic order on a totally ordered state space and considers only the steady-state analysis. My work consist in improving the complexity of these algorithms and the accuracy of the computed bounds, as well as in extending this approach to transient analysis, and particularly to first passage and absorption time bounds.

Comparing Markov chains uses two sufficient conditions: the comparison of their transition matrices and the stochastic monotonicity. Considering different stochastic orderings on random variables and different orders of states of the model allows to modify the complexity of these two conditions and their impact on the accuracy of bounds. Many natural phenomena are monotone when we consider only a partial order on the state space. I study the monotonicity of different models under the partial order of states and I try to exploit this natural monotonicity by proposing bounding algorithms that are specially adapted to monotone systems. Besides the classical strong stochastic ordering, I consider also increasing convex ordering and level-crossing ordering of Markov chains. Increasing convex ordering allows to compare the variability of random variables and it is thus particularly well adapted for the worst case analysis when we know only some partial information on the model. For instance, when we need to dimension a buffer knowing only the maximal and the mean size for the arrival process. Level-crossing ordering allows to obtain less restrictive comparison constraints when we study first passage or absorption times, as the time before a failure in a computer system or end-to-end delay in a packet switching network.

Beyond stochastic orderings and bounding techniques, I am interested in various concepts of stochastic monotonicity and their wide range of applications, some examples being acceleration of simulation techniques or convergence of iterative algorithms.

Most of my results are motivated by problems arising from communication networks, particularly optical networks, and recently, in smaller extent, also from operations management.

Keywords

Markov chain modeling, stochastic comparison, bounding techniques, reliability, performance evaluation.

Publications

Electronic versions can be found at:

<http://membres-lig.imag.fr/busic/publications.html>.

The names of authors are given in alphabetical order, except in [5, 13].

Journals

- [1] M. Ben Mamoun, A. Busic, N. Pekergin. *Generalized class C Markov chains and computation of closed-form bounding distributions*. Probability in the Engineering and Informational Sciences. Cambridge University Press, 21(2):235-260, 2007.

International conferences

- [2] D. Barth, A. Busic, J.-M. Fourneau, D. Nott, F. Quessette, S. Rousseau. *Guaranteeing burst routing in the ROMEO optical network*. In Proceedings of Asia-Pacific Optical Communications 2007 (APOC'07), Wuhan, China. SPIE. (Invited paper.)
- [3] A. Busic, T. Czachorski, J.-M. Fourneau and K. Grochla. *Level Crossing Ordering of Markov Chains: Computing End to End Delays in an All Optical Network*. In Proceedings of Value-tools'07, October 2007, Nantes, France.
- [4] A. Busic, N. Pekergin. *Closed Form Absorption Time Bounds*. 4th European Performance Engineering Workshop (EPEW 2007), September 2007, Berlin, Germany. LNCS 4748, Springer-Verlag, pp. 33-47.
- [5] A. Busic, M. Ben Mamoun, J.-M. Fourneau. *Modeling Fiber Delay Loops in an All Optical Switch*. In Proceedings of the Third international Conference on the Quantitative Evaluation of Systems (QEST'06), pp. 93-102, September 2006, IEEE Computer Society.
- [6] M. Ben Mamoun, A. Busic, J.-M. Fourneau, N. Pekergin. *Increasing convex monotone Markov chains: Theory, algorithm and applications*. Markov Anniversary Meeting, June 2006, Charleston, SC, USA. Boson Books, pp. 189-210.
- [7] A. Busic, J.-M. Fourneau. *Bounds based on lumpable matrices for partially ordered state space*. In Proceeding of the 2006 Workshop on Tools For Solving Structured Markov Chains, (SMCtools '06), vol. 201. ACM Press.
- [8] A. Busic, J.-M. Fourneau, D. Nott. *Deflection Routing on a Torus is Monotone*. In: Second Multidisciplinary International Symposium on Positive Systems : Theory and Applications (POSTA06), August 2006, Grenoble, France. LNCIS 341, pp. 161-168, Springer.
- [9] A. Busic, J.-M. Fourneau, N. Pekergin. *Worst Case Analysis of Batch Arrivals with the Increasing Convex Ordering*. 3rd European Performance Engineering Workshop (EPEW 2006), June 2006, Budapest, Hungary. In: A. Horváth and M. Telek (Eds.): EPEW 2006, LNCS 4054, Springer-Verlag, pp. 196-210.
- [10] A. Busic, J.-M. Fourneau. *Bounds for Point and Steady-State Availability: An Algorithmic Approach Based on Lumpability and Stochastic Ordering*. 2nd European Performance Engineering Workshop (EPEW 2005), September 2005, Versailles, France. In: M. Bravetti et al. (Eds.): EPEW 2005 and WS-FM 2005, LNCS 3670, Springer-Verlag, pp. 94-108.
- [11] A. Busic, J.-M. Fourneau. *A Matrix Pattern Compliant Strong Stochastic Bound*. Modelling and Performance Evaluation for Quality of Service in Next Generation Internet, janvier 2005, Trento, Italy. In: M. Papazoglu and K. Yamazaki (eds.), Applications and the Internet SAINT 2005 Workshops. IEEE Computer Society, pp. 256-259.

Poster

- [12] A. Busic, J.-M. Fourneau. *Bounding transient and steady-state dependability measures through algorithmic stochastic comparison*. SIGMETRICS Perform. Eval. Rev. 34(2):11-12, 2006. (Extended abstract of a poster presented at Performance 2005).

National conferences and workshops

- [13] K. Grochla, T. Czachórski, A. Busic, J.-M. Fourneau. *Simulation Analysis of Deflection Routing in Hypercube*. In Proceedings of Polish Teletraffic Symposium, Zakopane 2007.
- [14] Vandy Bertin, Ana Bušić, Bruno Gaujal, Jean-Marc Vincent. *Can we use perfect simulation for non-monotonic Markovian systems?* Extended abstract. ROADEF 2008, Clermont-Ferrand, France, 25-27 February 2008.

Participation to research projects

- European project: *EuroNGI (Next Generation Internet)*
<http://eurongi.enst.fr>
- National project: *SurePaths*, ACI sécurité informatique
Members: IRISA (Rennes), ID (Grenoble) and PRiSM (Versailles)
<http://www-id.imag.fr/surepaths/>
- National project: *Simulation et Monotonie Stochastique en évaluation de performances (SMS)*, Projet Blanc 2005
Members: LIG (Grenoble) and PRiSM (Versailles)
- National project: *Checkbound*, ANR-06-SETI-002
Members: INT (Evry), LAMSADE (Paris-Dauphine), Marin Mersenne (Paris 1), LIG (Grenoble) and PRiSM (Versailles)
<http://www.lamsade.dauphine.fr/checkbound/>

Teaching

[TD (Travaux Dirigés) = small section classes]

- **2006 – 2007 :**
 - Simulation and experiments control, Master, 1st year (36h TD)
 - Introduction to cryptography and encoding, Licence, 2nd year (main lecturer: 18h lectures and 36h TD)
- **2005 – 2006 :**
 - Simulation and experiments control, Master, 1st year (18h TD)
 - Introduction to cryptography and encoding, Licence, 2nd year (36h TD)
 - Advanced C programming, Licence, 2nd year (12h TD)
- **2004 – 2005 :**
 - Introduction to computer science I, Licence, 1st year (30h TD)
 - Introduction to computer science II, Licence, 1st year (30h TD)

- **2003 – 2004 :**

- Java programming I, DEUG, 1st year (22h TD)
- Java programming II, DEUG, 1st year (44h TD)

Other

- Member of organization committee of: 9ième Atelier en Evaluation de Performances, Aussois 1-4 juin 2008. Web: <http://aep9.imag.fr/>
- **2003 – 2006:** Allocation de recherche (scholarship for PhD students delivered by French ministry of education and research)
- **2002 – 2003:** Bourse du Gouvernement Français (French Government scholarship for foreign students)
- **1992 – 1996:** Competitions in mathematics. Best result: 3rd place (2nd award) at national level (Croatia)
- **Languages :** English, French, Croatian
- **Hobbies :** chess, choral singing

References

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