Overview BPM / Process Mining Related AIS Research 2012

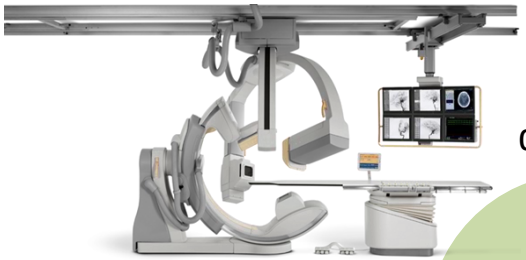
Wil van der Aalst

vdaalst.com

Technische Universiteit
Eindhoven
University of Technology

Where innovation starts

Architecture of Information Systems @ TU/e

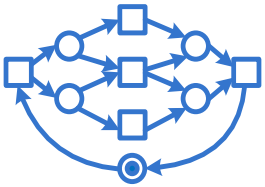


process discovery

BPM/WFM/ SOA systems

Process Mining

PAIS Technology

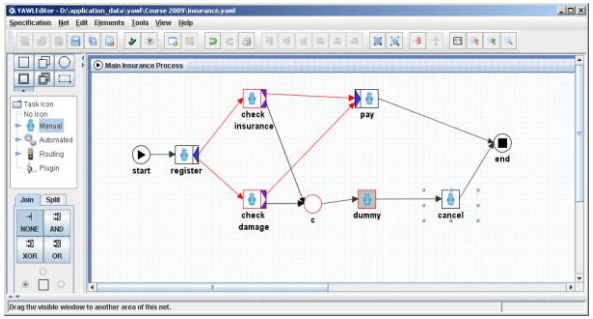


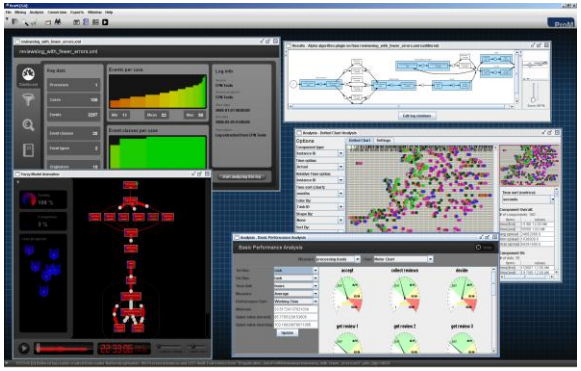
conformance checking

workflow patterns

simulation

Process Modeling/ Analysis



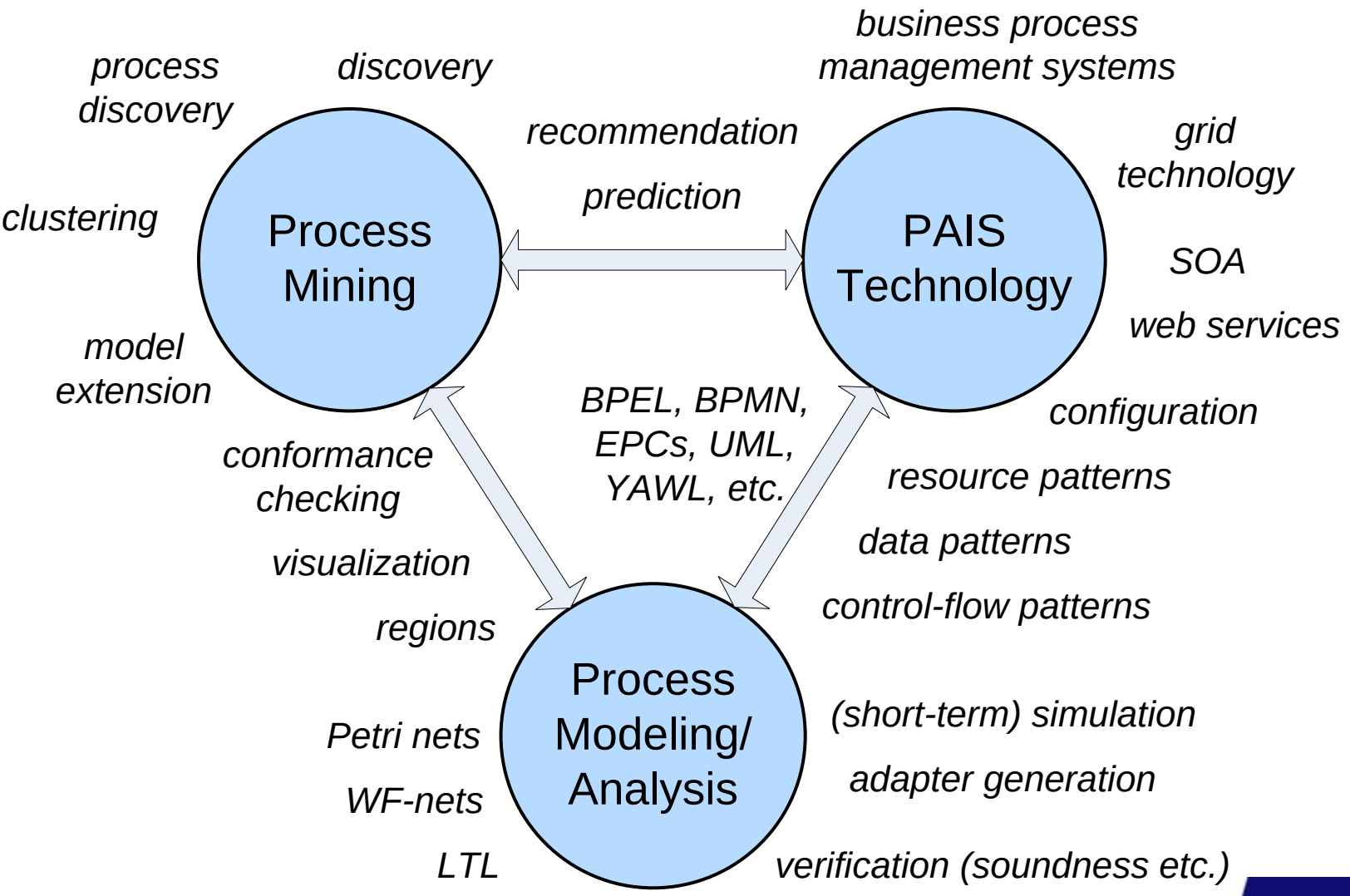


verification

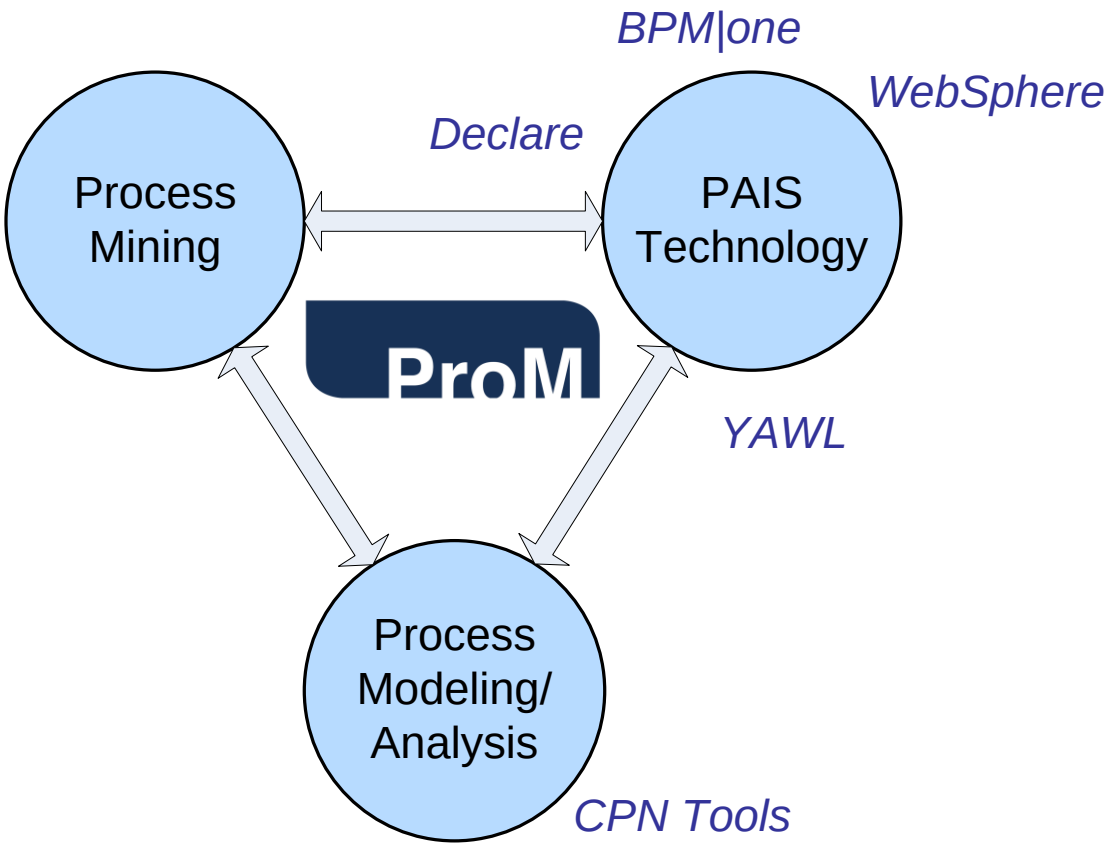
Mission Statement AIS

- **The Architecture of Information Systems (AIS) research group investigates *methods, techniques and tools for the design and analysis of Process-Aware Information Systems* (PAIS), i.e., systems that support business processes (workflows) inside and between organizations. We are not only interested in these information systems and their architecture, but also model and analyze the business processes and organizations they support.**
- **Our mission is to be one of the worldwide leading research groups in *process modeling and analysis*, *process mining*, and *PAIS technology*. We aim at results that are highly original and applicable in real-life situations.**
- **Our motto is "Process Technology that Works".**

Topics


process discovery
discovery
business process management systems
recommendation
prediction
grid technology
clustering
Process Mining
PAIS Technology
SOA
web services
model extension
BPEL, BPMN, EPCs, UML, YAWL, etc.
configuration
conformance checking
resource patterns
visualization
data patterns
regions
control-flow patterns
Process Modeling/ Analysis
(short-term) simulation
Petri nets
adapter generation
WF-nets
LTL
verification (soundness etc.)
extended WF-nets (open, with data, with resources)

Tools



"Process Technology that Works"

Highlights (1/2)

- **This group is well-known for its work on process mining, Petri nets, BPM, and WFM.**
- **The group got the highest possible ranking in the last evaluation of Dutch Computer Science research (5-5-5-5-5).**
- **The work is highly cited (e.g. Wil van der Aalst has an H-index of 92 according to Google Scholar) .**
- **The software tools (co-)developed by the group (e.g., ProM, Declare, CPN Tools, and YAWL) are widely known and used.**
- **AIS successfully launched two start-up companies: Fluxicon Process Laboratories and Futura Process Intelligence.**

Highlights (2/2)

- **Other companies such as Pallas Athena, IBM, IBIS, and Software AG adopted ideas developed at TU/e related to process mining and workflow modelling.**
- **The workflow patterns website (www.workflowpatterns.com) was initiated by the applicant and has been the most visited website on workflow management over the last 7 years.**
- **The open-source workflow system YAWL, developed in the ongoing collaboration with QUT, is one of the most widely used open-source workflow systems and used in various organizations (to date almost 120.000 downloads).**
- **The process mining tool ProM has been applied in hundreds of organizations ranging from municipalities and hospitals to high-tech manufacturers and multinationals.**

Recent AIS Work by Person

(selection, focus on BPM)

Arya Adriansyah

- Replay algorithms
- Alignments (cost-based, A*)
- Used for conformance checking (not just conformance checking, also see BPI paper on precision)
- Used for performance analysis (with nice visualizations)
- Causal nets

Joos Buijs

- Genetic process mining with particular representational bias
- Tree-like process models ensuring correctness
- Balancing all four conformance criteria: fitness, generalization, precision, and simplicity
- Discovering configurable models and balancing conformance and conservativeness (repair)
- XESame

Massimiliano de Leoni

- **Data-aware process mining:**
  - **decision mining**
  - **conformance checking with data and resources**
  - **generating data-mining problems from event logs**
- **Visualization of worklists and event logs (e.g., process mining movies like in the fuzzy miner but now played on any map)**
- **Artifact-centric process mining (multiple-instance problems, Proclets)**

Boudewijn van Dongen

- Replay algorithms (see work of Arya)
- Process discovery algorithms (genetic and ILP)
- Model similarity
- Artifact-centric process mining
- ProM infrastructure

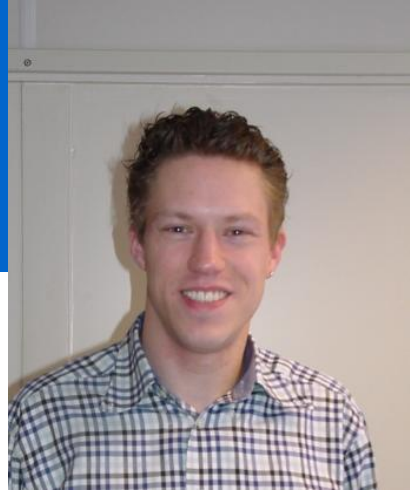
Dirk Fahland

- Model repair: if conformance is not acceptable, how to adapt the model?
- Model simplification: post-processing process mining results using unfoldings
- Artifact-centric process mining (Proclets)
  - focus on interacting instance (highly relevant for services)
  - conformance checking of artifact-centric models
  - discovery of artifact-centric models
- Verification
- Scenario-based modeling

Rafal Kocielnik

- Modeling and analyzing "daily-life", in particular stress-related health-problems
- Gathering sensor data (movement, hearth beats, etc.)
- Analyzing person related data thereby combining sensor data and other information (agenda, etc.)

Ronny Mans



- Process mining in healthcare
  - Data extraction
  - Application of existing algorithms
  - Addressing specific problems related to healthcare (e.g., timestamp problem)
- Proclets in healthcare
- Schedule-aware workflow systems
- YAWL extensions

Fabrizio Maggi

- Declare
- Discovery of declarative models
- Compliance checking of declarative models
- Operational support (warnings and on-the-fly anomaly detection)
- Monitoring system health

Joyce Nakatumba

- Mining of resource behavior in processes (e.g., effect of workload on performance)
- Short-term simulation
- Evaluating operational support techniques

Elham Ramezani

- Compliance checking based on Petri net patterns using replay algorithms
- Compliance checking while incorporating time, data, etc.
- Compliance management

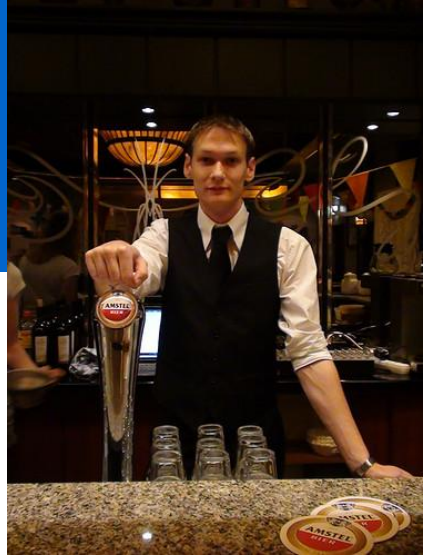
J.C. Rantham Prabhakara

- Dealing with low-level logs
- Trace alignment (for log inspection)
- Trace clustering
- Concept drift (second order dynamics, i.e., detecting that a process changes and locating the differences)
- Discovery of hierarchical models based on identifying repeating groups of patterns
- Analyzing
- (see http://alexandria.tue.nl/extra2/730954.pdf for thesis)

Hajo Reijers

- Also working for Perceptive Software (Lexmark/Pallas Athena)
- Understandability of process models (e.g., patterns to improve understandability)
- Managing large process model collections
- Business process reengineering
- Empirical BPM research

Dennis Schunselaar



- Configurable process models using CoSeNets (tree-like structure, always correct)
- Configurable Declare models
- Model merging (based on CoSeNets)

Natalia Sidorova

- Verification problems (workflow nets with resources and workflow nets with data)
- Verification of services (composition and refinement)
- Stress@Work (supervisor Rafal)
- Earlier: process mining on grids

Christian Stahl

- Modeling and analyzing services
- Operating guidelines (characterization of all possible correct partner services)
- Service substitution, composition, and migration
- Verification of workflow nets with data

Eric Verbeek

- ProM infrastructure
- Workflow verification
- Passages
- Configurable models (see Dennis)
- Context-aware compliance checking (see JM)

Jan Martijn van der Werf

- Auditing, compliance, and process mining
- Context-aware compliance checking (checking constraints using ontologies and logs)
- Earlier: verification

Michael Westergaard

- CPN Tools, Declare, and ProM
- Declarative models
- Simulation
- Efficiently checking and enacting declare models (looking into the future)
- Operational support (also connecting ProM / CPN Tools)

Some more pointers

Pointers to Recent Work (1/9)

General

- **W.M.P. van der Aalst. *Process Mining: Discovery, Conformance and Enhancement of Business Processes*. Springer-Verlag, Berlin, 2011.**
- **W.M.P. van der Aalst and C. Stahl. *Modeling Business Processes: A Petri Net Oriented Approach*. MIT press, Cambridge, MA, 2011.**
- **IEEE Task Force on Process Mining. Process Mining Manifesto. In F. Daniel, K. Barkaoui, and S. Dustdar, editors, *Business Process Management Workshops*, volume 99 of *Lecture Notes in Business Information Processing*, pages 169-194. Springer-Verlag, Berlin, 2012.**

Alignments: conformance checking, performance analysis, and evaluating process discovery algorithms (Arya Adriansyah et al.)

- **W.M.P. van der Aalst, A. Adriansyah, and B. van Dongen. Replaying History on Process Models for Conformance Checking and Performance Analysis. *WIREs Data Mining and Knowledge Discovery*, 2(2):182-192, 2012.**
- **Adriansyah, B. van Dongen, and W.M.P. van der Aalst. Conformance Checking using Cost-Based Fitness Analysis. In C.H. Chi and P. Johnson, editors, *IEEE International Enterprise Computing Conference (EDOC 2011)*, pages 55-64. IEEE Computer Society, 2011.**
- **Adriansyah, B.F. van Dongen, W.M.P. van der Aalst. Cost-Based Conformance Checking using the A* Algorithm. In BPM Center Report BPM-11-11, BPMcenter.org, 2011.**
- **A. Adriansyah, J. Munoz-Gama, J. Carmona, B.F. van Dongen, W.M.P. van der Aalst. Alignment Based Precision Checking. BPM Center Report BPM-12-10, BPMcenter.org, 2012.**

Pointers to Recent Work (2/9)

Auditing (Elham Ramezani, Jan Martijn van der Werf, et al.)

- **W.M.P. van der Aalst, K.M. van Hee, J.M. van der Werf, and M. Verdonk. Auditing 2.0: Using Process Mining to Support Tomorrow's Auditor. IEEE Computer, 43(3):90-93, 2010.**
- **E. Ramezani, D. Fahland W.M.P. van der Aalst. Where Did I Misbehave? Diagnostic Information in Compliance Checking. . In *Business Process Management (BPM 2012)*, *Lecture Notes in Computer Science*. Springer-Verlag, Berlin, 2012.**
- **J.M. van der Werf, E. Verbeek, and W.M.P. van der Aalst, Context-Aware Compliance Checking. In *Business Process Management (BPM 2012)*, *Lecture Notes in Computer Science*. Springer-Verlag, Berlin, 2012.**

Trace alignment (JC Bose et al.)

- **R.P. Jagadeesh Chandra Bose and W.M.P. van der Aalst. Process Diagnostics Using Trace Alignment: Opportunities, Issues, and Challenges. *Information Systems*, 37(2):117-141, 2012.**

Mining resource behavior (Joyce Nakatumba et al.)

- **J. Nakatumba and W.M.P. van der Aalst. Analyzing Resource Behaviour Using Process Mining 5th Workshop on Business Process Intelligence (BPI' 09) 2009.**

Configurable process models (comparing/merging models)

- **J.J.C.L. Vogelaar, H.M.W. Verbeek, B. Luka, and W.M.P. van der Aalst. Comparing Business Processes to Determine the Feasibility of Configurable Models: A Case Study. In F. Daniel, K. Barkaoui, and S. Dustdar, editors, *Business Process Management Workshops, International Workshop on Process Model Coll* volume 100 of *Lecture Notes in Business Information Processing*, pages 50-61. Springer-V**

Pointers to Recent Work (3/9)

Decomposing process mining problems (Wil van der Aalst et al.)

- W.M.P. van der Aalst. Decomposing Process Mining Problems Using Passages. In S. Haddad and L. Pomello, editors, *Applications and Theory of Petri Nets 2012*, volume 7347 of *Lecture Notes in Computer Science*, pages 72-91. Springer-Verlag, Berlin, 2012.
- W.M.P. van der Aalst. Distributed Process Discovery and Conformance Checking. In J. de Lara and A. Zisman, editors, International Conference on Fundamental Approaches to Software Engineering (FASE 2012), volume 7212 of Lecture Notes in Computer Science, pages 1-25. Springer-Verlag, Berlin, 2012.
- C. Bratosin, N. Sidorova, and W.M.P. van der Aalst. Distributed Genetic Process Mining Using Sampling. In V. Malyshkin, editor, *Parallel Computing Technologies (PaCT 2011)*, volume 6873 of *Lecture Notes in Computer Science*, pages 224-237. Springer-Verlag, Berlin, 2011.

Operational support (prediction and recommendation) (Michael Westergaard et al.)

- W.M.P. van der Aalst, M. Pesic, and M. Song. Beyond Process Mining: From the Past to Present and Future. In B. Pernici, editor, *CAiSE'10*, volume 6051 of *Lecture Notes in Computer Science*, pages 38-52. Springer-Verlag, Berlin, 2010.
- J. Nakatumba, M. Westergaard, and W. M. P. van der Aalst, “Testing Algorithms for Operational Support Using Colored Petri Nets,” in Proc. of Petri Nets, 2012.
- F. M. Maggi, M. Westergaard, M. Montali, and W. M. P. van der Aalst, “Runtime Verification of LTL-Based Declarative Process Models,” in Proc. of RV, 2011.
- W.M.P. van der Aalst, M.H. Schonenberg, and M. Song. Time Prediction Based on Process Mining. Information Systems, 36(2):450-475, 2011.

Pointers to Recent Work (4/9)

Discovery and conformance checking of declarative models (Fabrizio Maggi et al.)

- **F.M. Maggi, R.P. Jagadeesh Chandra Bose, and W.M.P. van der Aalst. Efficient Discovery of Understandable Declarative Process Models from Event Logs. In *Caise 2012*, *Lecture Notes in Computer Science*, Springer-Verlag, Berlin, 2012.**
- **F.M. Maggi, M. Montali, and W.M.P. van der Aalst. An Operational Decision Support Framework for Monitoring Business Constraints. In J. de Lara and A. Zisman, editors *FASE 2012*, volume 7212 of *Lecture Notes in Computer Science*, pages 146-162. Springer-Verlag, Berlin, 2012.**
- **F.M. Maggi, A.J. Mooij, and W.M.P. van der Aalst. User-Guided Discovery of Declarative Process Models. In N. Chawla, I. King, and A. Sperduti, editors, *IEEE Symposium on Computational Intelligence and Data Mining (CIDM 2011)*, pages 192-199, Paris, France, April 2011. IEEE.**
- **M. Montali, M. Pesic, W.M.P. van der Aalst, F. Chesani, P. Mello, and S. Storari. Declarative Specification and Verification of Service Choreographies. *ACM Transactions on the Web*, 4(1):1-62, 2010.**
- **M. De Leoni, F.M. Maggi, and W.M.P. van der Aalst. Aligning Event Logs and Declarative Process Models for Conformance Checking. . In *Business Process Management (BPM 2012)*, *Lecture Notes in Computer Science*. Springer-Verlag, Berlin, 2012.**
- **F.M. Maggi, M. Westergaard, M. Montali, and W.M.P. van der Aalst. Runtime Verification of LTL-Based Declarative Process Models. In S. Khurshid and K. Sen, editors, Runtime Verification (RV 2011), volume 7186 of Lecture Notes in Computer Science, pages 131-146. Springer-Verlag, Berlin, 2012.**

Pointers to Recent Work (5/9)

Cross-organizational process mining (Joos Buijs et al.)

- **J.C.A.M. Buijs, B.F. van Dongen, and W.M.P. van der Aalst. Towards Cross-Organizational Process Mining in Collections of Process Models and their Executions. In F. Daniel, K. Barkaoui, and S. Dustdar, editors, *Business Process Management Workshops, International Workshop on Process Model Collections (PMC 2011)*, volume 100 of *Lecture Notes in Business Information Processing*, pages 2-13. Springer-Verlag, Berlin, 2012.**
- **W.M.P. van der Aalst. Intra- and Inter-Organizational Process Mining: Discovering Processes within and between Organizations. In P. Johannesson and J. Krogstie, editors, *IFIP Conference on the Practice of Enterprise Modelling (PoEM 2011)*, volume 92 of *Lecture Notes in Business Information Processing*, pages 1-11. Springer-Verlag, Berlin, 2011.**

Model simplification and repair (Dirk Fahland et al.)

- **D. Fahland and W.M.P. van der Aalst. Simplifying Mined Process Models: An Approach Based on Unfoldings. In S. Rinderle, F. Toumani, and K. Wolf, editors, *Business Process Management (BPM 2011)*, volume 6896 of *Lecture Notes in Computer Science*, pages 362-378. Springer-Verlag, Berlin, 2011.**
- **D. Fahland and W.M.P. van der Aalst Repairing Process Models to Reflect Reality. In *Business Process Management (BPM 2012)*, *Lecture Notes in Computer Science*. Springer-Verlag, Berlin, 2012.**

Pointers to Recent Work (6/9)

Representational bias in process mining (Wil van der Aalst et al.)

- **W.M.P. van der Aalst. On the Representational Bias in Process Mining (Keynote Paper). In S. Reddy and S. Tata, editors, Proceedings of the 20th Workshops on Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE 2011), pages 2-7, Paris, 2011. IEEE Computer Society Press.**
- **W.M.P. van der Aalst, A. Adriansyah, and B.F. van Dongen. Causal Nets: A Modeling Language Tailored Towards Process Discovery. In J.P. Katoen and B. Koenig, editors, *22nd International Conference on Concurrency Theory (CONCUR 2011)*, Lecture Notes in Computer Science, pages 28–-42. Springer-Verlag, Berlin, 2011.**

Genetic tree mining (Joos Buijs et al.)

- **J.C.A.M. Buijs, B.F. van Dongen, W.M.P. van der Aalst - A Genetic Algorithm for Discovering Process Trees. 2012 IEEE Congress on Evolutionary Computation, Brisbane, 2012.**
- **W.M.P. van der Aalst, J.C.A.M. Buijs, B.F. van Dongen - Towards Improving the Representational Bias of Process Mining. 'IFIP 2.6 - 2.12 First International Symposium on Data-Driven Process Discovery and Analysis, 2012.**

Pointers to Recent Work (7/9)

Concept drift (JC Bose et al.)

- **R.P. Jagadeesh Chandra Bose, W.M.P. van der Aalst, I. Zliobaite, and M. Pechenizkiy. Handling Concept Drift in Process Mining. In H. Mouratidis and C. Rolland, editors, *International Conference on Advanced Information Systems Engineering (Caise 2011)*, volume 6741 of *Lecture Notes in Computer Science*, pages 391-405. Springer-Verlag, Berlin, 2011.**

Support for log/model abstraction (JC Bose et al.)

- **R.P. Jagadeesh Chandra Bose, H.M.W. Verbeek, and W.M.P. van der Aalst. Discovering Hierarchical Process Models Using ProM. In S. Nurcan, editor, *IS Olympics: Information Systems in a Diverse World*, volume 107 of *Lecture Notes in Business Information Processing*, pages 33-38. Springer-Verlag, Berlin, 2012.**
- **R.P. Jagadeesh Chandra Bose and W.M.P. van der Aalst. Abstractions in Process Mining: A Taxonomy of Patterns. In U. Dayal, J. Eder, J. Koehler, and H. Reijers, editors, *Business Process Management (BPM 2009)*, volume 5701 of *Lecture Notes in Computer Science*, pages 159-175. Springer-Verlag, Berlin, 2009.**

Process mining and visual analytics (Massimiliano de Leoni et al.)

- **W.M.P. van der Aalst, M. de Leoni, A.H.M. ter Hofstede. Process Mining And Visual Analytics: Breathing life into business process models. In Computational Intelligence, Floares (Ed.), Nova Science Publishers 2012.**

Pointers to Recent Work (8/9)

Data-aware process mining (Massimiliano de Leoni et al.)

- **M. de Leoni, W.M.P. van der Aalst, B.F. van Dongen. Data- and Resource-aware Conformance Checking of Business Processes. In Proc. of the 15th International Conference on Business Information Systems (BIS 2012), 2012.**

Process mining in healthcare (Ronny Mans et al.)

- **R.S. Mans, M.H. Schonenberg, M. Song, W.M.P. van der Aalst, and P.J.M. Bakker. Application of Process Mining in Healthcare: A Case Study in a Dutch Hospital. In *Biomedical Engineering Systems and Technologies*, volume 25 of *Communications in Computer and Information Science*, pages 425-438. Springer-Verlag, Berlin, 2009.**

Extended heuristics mining (Joel Ribeiro et al.)

- **J.T.S. Ribeiro and A.J.M.M. Weijters (2011), Event Cube: Another Perspective on Business Processes. In: OTM 2011. Lecture Notes in Computer Science 7044 Springer 2011, pp 274-283.**
- **A.J.M.M. Weijters, J.T.S. Ribeiro (2011). Flexible Heuristics Miner (FHM). In: Proceedings of the IEEE Symposium on Computational Intelligence and Data Mining, CIDM 2011, part of the IEEE Symposium Series on Computational Intelligence 2011.**

Pointers to Recent Work (9/9)

Artifact-centric process mining (ACSI)

- D. Fahland, M. de Leoni, B.F. van Dongen, and W.M.P. van der Aalst. Conformance Checking of Interacting Processes with Overlapping Instances. In S. Rinderle, F. Toumani, and K. Wolf, editors, Business Process Management (BPM 2011), volume 6896 of Lecture Notes in Computer Science, pages 345-361. Springer-Verlag, Berlin, 2011.
- D. Fahland, M. de Leoni, B.F. van Dongen, and W.M.P. van der Aalst. Conformance Checking of Interacting Processes with Overlapping Instances. In S. Rinderle, F. Toumani, and K. Wolf, editors, *Business Process Management (BPM 2011)*, volume 6896 of *Lecture Notes in Computer Science*, pages 345-361. Springer-Verlag, Berlin, 2011.
- D. Fahland, M. De Leoni, B. van Dongen, and W.M.P. van der Aalst. Many-to-Many: Some Observations on Interactions in Artifact Choreographies. In D. Eichhorn, A. Koschmider, and H. Zhang, editors, *Proceedings of the 3rd Central-European Workshop on Services and their Composition (ZEUS 2011)*, CEUR Workshop Proceedings. CEUR-WS.org, 2011.

Home | Keynotes | Latest news

Search

Program

Practical details

Calls for Contributions

- Call for Papers
- Call for Workshop

Committees

- Conference Committee
- Program Committee
- Steering Committee

Welcome to BPM 2013

Posted by bpm on July 4, 2012

BPM 2013 is the eleventh edition of the reference conference for researchers and practitioners in the field of Business Process Management (BPM). The conference covers all aspects of BPM, including theory, models, techniques, architectures, systems, and empirical studies, and engages the most renowned representatives of the BPM community worldwide in talks, tutorials, and scientific discussions.

BPM 2013 will take place in Beijing, the capital of China, and it will be the first edition of the BPM conference series in Asia. Next to the world-famous sites of the Great Wall, the Summer Palace, the Forbidden City, and Tiantan – four world cultural heritage sites recognized by UNESCO – Beijing hosts a constantly growing concentration of cutting-edge, industrial research labs and academic institutions from all over the world, making it a melting pot of creativity and innovation.

Platinum Sponsor

清華大學 Tsinghua University

http://bpm2013.tsinghua.edu.cn/

Call for Workshop Proposals

Posted by bpm on August 17, 2012