

1) A. Chaintreau, J.-Y. Le Boudec, N. Ristanovic

The age of gossip: spatial mean field regime

Proceedings of the eleventh international joint conference on Measurement and modeling of computer systems, pages 109-120, 2009

DOI [10.1145/1555349.1555363](https://doi.org/10.1145/1555349.1555363)

Used by the Quanticol project

The authors develop a mean field model of movement and data ageing using real data collected from cabs in the San Francisco Bay area. The region is divided into 15 regular patches in a grid with a sixteenth patch representing the rest of the world (although only four patches connect directly to the sixteenth patch due to the geography).

They first develop an ODE model of movement between patches which describes the number of cabs in each patch over time. This is later parameterised by the real data. The system to model how data ages is then described as a set of PDEs with one PDE for each patch. It takes into account movement between patches, the ageing of data, and how each cab can obtain younger data either from a base station or from other cabs. Rates to describe the occurrence of opportunistic contacts between cabs in the same patch, and in neighbouring patches are again derived from the real data. Although the model is expressed as a PDE (due to two variables, time and age), the spatial aspect is treated discretely.

The PDEs have a unique solution defined as a non-linear ODE problem. Analytic results are provided for the single-patch case, and the multi-patch case is approximated by considering low age and high age asymptotics. Validation is performed on the model, and then experiments are performed to investigate different approaches to locating base stations. The output of the model is considered spatially, in the sense that values are provided for each patch rather than averaging across all patches.

The paper is interesting as a patch model, and provides some ideas for parameterisation when detailed GPS data is available.

2) R Durrett, S Levin

The Importance of Being Discrete (and Spatial)

Theoretical population biology, Volume 46, Issue 3, December 1994, Pages 363–394

DOI <http://dx.doi.org/10.1006/tpbi.1994.1032>

Used by the Quanticol project

The Importance of Being Discrete (and Spatial): This paper compares four approaches to the modelling of spatially distributed systems. Mean-field approach (no spatial representation, individuals treated homogeneously), Reaction-diffusion approach (extend mean-field approach by adding reaction-diffusion factor), Patch models (group individuals to patches, patches have no difference, and can interact with all the rest patches stochastically), Interacting particle system (subdivide space into a grid of cells, individuals in a cell can only interact with their neighbours).

Case studies: Case 1: one species enhances the presence of the other -> all four approaches agree. Case 2: two species compete with a single resource-> the models with spatial representations disagree with the ones without spatial representation. Case 3: one species always do better than the other, but if the other dies out, it will also go extinction-> the first two approaches show that both the species die out, however the latter two approaches show that they can coexist.

3) G.Marion, G.J.McInerny, J.Pagel, S.Catterall, A.R.Cook, F.Hartig and R.B.O'Hara

Parameter and uncertainty estimation for process-oriented population and distribution models: data, statistics and the niche

Journal of Biogeography, 2012, Volume 39, Issue 12, pages 2225–2239

DOI: 10.1111/j.1365-2699.2012.02772.x

Used by the Quanticol project

This is a review paper which gives an introduction to parameter estimation in the Bayesian framework based on MCMC. Thus there are no original results but a clear explanation of existing techniques illustrated by three case studies of increasing complexity, both in terms of the models and the availability of data, starting from a deterministic model which is assumed to be in equilibrium and for which there is spatial data only for one time point, to a stochastic model with two time points, to a more complete time series and more detailed mechanistic model.

4) Contardo, Claudio, Catherine Morency, and Louis-Martin Rousseau

Balancing a dynamic public bike-sharing system

CIRRELT, 2012.

<https://www.cirrelt.ca/DocumentsTravail/CIRRELT-2012-09.pdf>

Used by the Quanticol project

In this paper, a set of mathematical formulations and solution methodologies are provided for a dynamic public bike-sharing balancing problem arising from the daily operations. They first propose an arc-flow formulation on a space-time network. In their space-time network, the time horizon is discrete into indexed short periods, each node on the network represents the state of a station at time t : $S(v,t)$, where v is the station id, t is the time index. The arcs indicate vehicles' direct trips between a pair of states or the action of waiting at a station for a period. The goal of the arc-flow formulation is to minimize the value of the total shortage and excess of bikes at all states in the space-time network. As a solution of the arc-flow formulation may not be feasible, they further introduced a heuristic procedure based on the solution of two different decompositions (Dantzig-Wolfe decomposition and Benders decomposition) of the problem. They first apply Dantzig-Wolfe decomposition to the arc-flow formulation which allows them to obtain a lower bound of the problem. Then, they apply Benders decomposition to another reformulation of the problem and use the information provided by the first solution so as to obtain an upper bound of the problem. In their experiments, we test their algorithm in the setting of different number of stations and

time periods, and different topology of stations (clustered, randomly distributed). It shows that their method can provide solution in reasonable time in different settings.

5) Raviv, Tal, Michal Tzur, and Iris A. Forma

Static repositioning in a bike-sharing system: models and solution approaches

EURO Journal on Transportation and Logistics (2013) Vol 2, Issue 3, pp- 187-229

DOI 10.1007/s13676-012-0017-6

Used by the Quanticol project

Static repositioning refers to repositioning bikes among stations during night time in order to suit the demand of the next day. In the paper, the authors use a convex penalty function for each station $f(S_i)$ to represent the expected number of shortage events for the next day, where S_i is the number of bikes in the i th station after reposition. The goal is to minimise $w_1 * (f(S_0) + f(S_1) + \dots + f(S_n)) + w_2 * OC$, where w_1 and w_2 are two scale factors, OC refers to the total operation cost.

In their first model of an arc-indexed formulation, the vehicle's route consists of indexed-arcs between stations, and each station can only be visited once. The vehicle loads on and off some bikes when visiting each station. In their second model of a time-indexed formulation, the time available for repositioning of bikes is discrete into slots of short period. In each time slot, some stations can be visited and repositioning operation can be undertaken in these stations. By doing this, a station can be visited multiple times. Both of the models can be converted to a Mixed Integer Linear Programming problem and solved.

6) F. Mondada, A. Martinoli, N. Correll, A. Gribovskiy and J. I. Halloy et al.

A general methodology for the control of mixed natural-artificial societies

Handbook of Collective Robotics: Fundamentals and Challenges, Pan Stanford Publishing, p. 399-428, 2013.

<http://www.crcpress.com/product/isbn/9789814316422>

Used by the ASSISlbf project

Mixed societies are dynamical systems, where animals and artificial agents interact and cooperate to produce shared collective intelligence. In this text is discussed the methodology for the design of a lure capable of sending relevant cues to animal, of sensing the animal response and of adapting its behaviour, in order to provoke particular responses in collective animal societies. Two types of robotized lures designed using this methodology are presented, the InsBot that has been created to interact with societies of cockroaches and the PoulBot for interaction with chicks societies.

7) F. Bonnet, P. Rétornaz, J. I. Halloy, A. Gribovskiy and F. Mondada.

Development of a mobile robot to study the collective behavior of zebrafish

Proceedings of the IEEE RAS-EMBS International Conference on Biomedical Robotics and Biomechatronics, Roma, Italy, 2012.

DOI [10.1109/BioRob.2012.6290826](https://doi.org/10.1109/BioRob.2012.6290826)

Used by the ASSISIBf project

A robot accepted by animals as conspecifics is a very powerful tool in behavioral biology, particularly in studies of Mixed societies, where animals and artificial agents interact and cooperate to produce shared collective intelligence. In this paper, a robotic zebrafish designed for experiments on the collective animal behaviour is presented. The robot consists of two modules: a replica fish fixed on the magnetic base and a miniature mobile robot guiding the replica fish from below the experimental tank.

8) Vaughan, R., Sumpter, N., Henderson, J., Frost, A., & Cameron, S.

Experiments in automatic flock control

Robotics and Autonomous Systems, 31(1), 109-117, 2000.

DOI:10.1016/S0921-8890(99)00084-6

Used by the ASSISIBf project

The Robot Sheepdog Project has developed a mobile robot that gathers a flock of ducks and manoeuvres them safely to a specified goal position. This is the first example of a robot system that exploits and controls an animal's behaviour to achieve a useful task. A potential-field model of flocking behaviour was constructed and used to investigate methods for generalised flock control. One possible algorithm is described and demonstrated to work both in simulation and in the real world.

9) Halloy, J., Sempo, G., Caprari, G., Rivault, C., Asadpour, M., Tache, F., Saïd, I., Durier, V., Canonge, S., Amé, J. M., Detrain, C., Correll, N., Martinoli, A., Mondada, F., Siegwart, r., Deneubourg, J. L.

Social integration of robots into groups of cockroaches to control self-organized choices

Science, 318(5853), 1155-1158, 2007.

DOI: 10.1126/science.1144259

Used by the ASSISIBf project

In this experimental study, we show collective decision-making by mixed groups of cockroaches and socially integrated autonomous robots, leading to shared shelter selection. Individuals, natural or artificial, are perceived as equivalent, and the collective decision emerges from nonlinear feedbacks based on local interactions. Even when in the minority, robots can modulate the collective decision-making process and produce a global pattern not observed in their absence. These results demonstrate the possibility of using

intelligent autonomous devices to study and control self-organized behavioral patterns in group-living animals.

10) Landgraf, T., Oertel, M., Rhiel, D., & Rojas, R.

A biomimetic honeybee robot for the analysis of the honeybee dance communication system

IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2010 (pp. 3097-3102). IEEE, 2010.

DOI 10.1109/IROS.2010.5650930

Used by the ASSISlbf project

A new biomimetic honeybee robot capable of dancing mimicking all known signals in the honeybee dance communication system has been built. This paper describes the hard- and software design of the first honeybee robot with computer vision. The robot can robustly recognize obstacles and react on imminent collisions.

11) Mariano, Pedro, and Luis Correia.

Population Dynamics of Centipede Game using an Energy Based Evolutionary Algorithm

Advances in Artificial Life, ECAL. Vol. 12. 2013.

DOI <http://dx.doi.org/10.7551/978-0-262-31709-2-ch168>

Used by the ASSISlbf project

In the context of Evolutionary Game Theory, we have developed an evolutionary algorithm without an explicit fitness function or selection function. Instead players obtain energy by playing games. To avoid exponential growth of the population there is a death event that depends on population size. By tweaking with the relation between payoff and energy and with death event, we create another dilemma that a population must overcome: extinction. We demonstrate this phenomena in the Centipede game.

12) Silva, Fernando, Luís Correia, and Anders Lyhne Christensen.

Dynamics of Neuronal Models in Online Neuroevolution of Robotic Controllers

Progress in Artificial Intelligence. Springer Berlin Heidelberg, LNAI 8154, 2013. 90-101.

DOI 10.1007/978-3-642-40669-0_9

Used by the ASSISlbf project

In this paper, we investigate the dynamics of different neuronal models on online neuroevolution of robotic controllers in multirobot systems. We compare the performance and robustness of neural network-based controllers using summing neurons, multiplicative neurons, and a combination of the two.

13) Szopek, M., Schmickl, T., Thenius, R., Radspieler, G., & Crailsheim, K.

Dynamics of Collective Decision Making of Honeybees in Complex Temperature Fields

PloS one, 8(10), e76250, 2013.

DOI [10.1371/journal.pone.0076250](https://doi.org/10.1371/journal.pone.0076250)

Used by the ASSISlbf project

Freshly emerged honeybees have a preferred temperature near 36 °C. However, in an arena with a complex thermal environment single bees are hardly able to locate themselves at their optimal temperature whereas groups of bees aggregate there. In this study we investigate this collective thermotaxis of honeybees in complex thermal environments. The bees exhibit collective decision making by modulating the resting time after encountering another bee according to the locally perceived temperature. This behaviour not only enables the bees to collectively choose the optimal temperature spot, they also successfully discriminate a global from a local optimum. We show that the collective thermotaxis enables groups of bees to perform complex tasks despite the limited abilities of each individual.

14) Adina Sirbu, Annapaola Marconi, Marco Pistore, Hanna Eberle, Frank Leymann and Tobias Unger

Dynamic Composition of Pervasive Process Fragments

Proceedings of the 9th IEEE International Conference on Web Services (ICWS), 2011

DOI [10.1109/ICWS.2011.70](https://doi.org/10.1109/ICWS.2011.70)

Used by the ALLOW Ensembles project

A critical aspect for pervasive computing is the possibility to discover and use process knowledge at run time depending on the specific context. This can be achieved by using an underlying service-based application and exploiting its features in terms of dynamic service discovery, selection, and composition. Pervasive process fragments represent a service-based tool that allows to model incomplete and contextual knowledge. This paper provides a solution to automatically compose such fragments into complete processes, according to a specific context and specific goals. The solution is computed by encoding process knowledge, domain knowledge and goals into an AI planning problem. The approach is evaluated on different scenarios stress testing the main characteristics of pervasive process fragments.

15) Christian Hiesinger, Daniel Fischer, Stefan Föll, Klaus Herrmann and Kurt Rothermel

Minimizing Human Interaction Time in Workflows

Proceedings of the Sixth International Conference on Internet and Web Applications and Services (ICIW), 2011

http://www.thinkmind.org/index.php?view=article&articleid=iciw_2011_1_40_20083

Used by the ALLOW Ensembles project

Many business scenarios require humans to interact with workflows. To support humans as unobtrusively as possible in the execution of their activities, it is important to keep the interaction time experienced by humans as low as possible. The time required for such interactions is influenced by two factors: First, by the runtime of the services that are used by a workflow during an interaction. Second, by the time required to transfer data between workflow servers and services that may be distributed in a global network. This paper proposes an algorithm that computes a suitable distribution of a workflow in such a network. The goal of the proposed algorithm is to minimize the time required for interactions between a human and a workflow. Current approaches in the domain of workflow optimization pay little attention towards optimizing a workflow to increase the usability for humans. The authors show the feasibility of their approach by comparing the proposed algorithm with two non-distributed approaches and a distributed approach which is based on a greedy algorithm and show that the proposed algorithm outperforms these approaches.

16) Hannes Wolf, Klaus Herrmann, Kurt Rothermel

FlexCon – Robust Context Handling in Human-Oriented Pervasive Flows

On the Move to Meaningful Internet Systems: OTM 2011 Confederated International Conferences: CoopIS, DOA-SVI, and ODBASE 2011, Hersonissos, Crete, Greece, October 17-21, 2011, Proceedings, Part I

DOI 10.1007/978-3-642-25109-2_16

Used by the ALLOW Ensembles project

Workflows are increasingly becoming a universal means for driving and coordinating complex processes, not only in the business world but also in areas like pervasive computing. Pervasive flows run in parallel with the user's real-world actions and are synchronized using automatically collected context information about her current activities (context events). Respective workflows cannot be rigidly defined since the user needs to retain her flexibility and must not be obstructed by the workflow. However, if the order of activities is not defined until the activities are actually executed, correctly assigning the uncertain context events becomes a major challenge. This paper proposes FlexCon – a novel event assignment approach for such human-oriented workflows that is based on hybrid workflow models and Dynamic Bayesian Networks. FlexCon exploits the dependency between context events to provide more accurate information as to which events need to be consumed by which workflow activities. Authors' evaluations show that FlexCon improves the event accuracy on average by 54% and the number of successful completed flows on average by 88%. Thus, FlexCon represents a major step towards unobtrusive pervasive applications.

17) Srdjan Marinovic, Robert Craven, Jiefei Ma, and Naranker Dulay

Rumpole: A Flexible Break-glass Access Control Model

Proceedings of the 6th ACM Symposium on Access Control Models and Technologies (SACMAT) , 2011

DOI [10.1145/1998441.1998453](https://doi.org/10.1145/1998441.1998453)

Used by the ALLOW Ensembles project

Access control operates under the assumption that it is possible to correctly encode and predict all subjects' needs and rights. However, in human-centric pervasive domains, such as health care, it is hard if not impossible to encode all emergencies and exceptions, but also to imagine a priori all the permissible requests. Break-glass is an approach that embodies the idea that under certain conditions it is possible for a subject to break-the-glass and explicitly overrides the denied request. Current break-glass models make this decision without considering and investigating what the reasons for issuing the denial are, and they have a fixed decision procedure to determine whether the override is permitted. Furthermore, they do not explicitly represent and reason over conflicting and missing information about subjects and the context; which in human-centric pervasive domains is a norm rather than an anomaly. This paper presents a novel break-glass model, Rumpole that structures a break-glass policy by establishing why the access was denied. It uses Belnap's four-valued logic to represent conflicting and missing (unknown) information, allowing the policy to make a more informed decision when faced with missing or inconsistent knowledge. The model also provides a declarative query language that is used to specify an explicit break-glass decision procedure, rather than having an implicitly hard-coded one. This allows a policy writer to further condition and restrict when and how break-glass access is permitted.

18) Ivan Lanese, Antonio Bucchiarone, and Fabrizio Montesi

A Framework for Rule-based Dynamic Adaptation

Proceedings of the 25th International Symposium on Trustworthy Global Computing (TGC), 2010

DOI [10.1007/978-3-642-15640-3_19](https://doi.org/10.1007/978-3-642-15640-3_19)

Used by the ALLOW Ensembles project

This paper proposes a new approach to dynamic adaptation, based on the combination of adaptation hooks provided by the adaptable application specifying where adaptation can happen, and adaptation rules external to the application, specifying when and how adaptation can be performed. The authors discuss different design choices that have to be considered when using such an approach, and then they propose a possible solution. They describe the solution in details, they apply it to a sample scenario and they implement it on top of the language Jolie.

19) Hanne Eberle, Frank Leymann, and Tobias Unger

Transactional Process Fragments - Recovery Strategies for Flexible Workflows with Process Fragments

Proceedings of the IEEE Asia-Pacific Services Computing Conference (APSCC), 2010

DOI [10.1109/APSCC.2010.73](https://doi.org/10.1109/APSCC.2010.73)

Used by the ALLOW Ensembles project

Transactional behavior in workflows was introduced to foster stable and foreseen workflow behavior, even in case a faulting situation occurs. Transactional behavior ensures that a workflow execution obtains a valid business state in the end, whatever faults might happen during execution. Flexibility concepts were introduced to be able to handle unforeseen situations in workflow executions. This paper presents recovery strategies for the flexibility workflow concept of process fragments. The proposed concept provides means to implement transactional behavior for process fragments, while preserving flexibility. Thereto, authors specify two recovery strategies for process fragments: the backward recovery strategy allows to compensate already executed process fragments of the dynamically composed process. The forward recovery strategy handles the occurring faults by executing repair actions.

20) Srdjan Marinovic, Kevin Twidle, Naranker Dulay and Morris Sloman

Teleo-Reactive Policies for Managing Human-centric Pervasive Services

Proceedings of the 6th International Conference on Network and Service Management (CNSM), 2010

DOI [10.1109/CNSM.2010.5691332](https://doi.org/10.1109/CNSM.2010.5691332)

Used by the ALLOW Ensembles project

Event-Condition-Action (ECA) policies are often used to manage various aspects of adaptation and execution of pervasive systems. Such policies are well suited for services where: 1) given actions are reliably executed when they are requested, 2) there is no priority ordering amongst multiple available actions, and 3) execution is instantaneous with respect to the validity of conditions under which they were initiated. However, for a pervasive service that integrates human agents and human activities, these assumptions do not generally hold. Humans may misbehave by postponing the execution of certain actions or ignoring them all together. Performing an action may take a long time so that the action is no longer needed or more important actions may need to be executed. Managing such behaviors through ECA policies is complex and difficult to implement. This paper introduces a new management policy type, called a Teleo-Reactive policy, whose semantics are based on continuous monitoring of the environment and prioritizing available actions. The semantics result in more flexible and concise formulation of management policies for human-centric pervasive services. The authors demonstrate how these policies can be applied in a real-world use case scenario set in a nursing home and describe the underlying implementation based on the Android's Java platform.

21) Gerd Kortuem, Fahim Kawsar, and Bashar Altakrouri

Flow-Driven Ambient Guidance

Proceedings of the 8th Annual IEEE International Conference on Pervasive Computing and Communications (PerCom) , 2010

DOI [10.1109/PERCOMW.2010.5470544](https://doi.org/10.1109/PERCOMW.2010.5470544)

Effectively guiding people in complex and highly dynamic work environment requires advances in high-level declarative activity models that can describe the flow of human work activities and their intended

outcomes, as well as novel user interface models for distributing guidance information across time and space. This paper describes a new line of research aimed at developing a new programming and human interface approach for pervasive systems based on high-level models of human activities, so-called situated flows, and mobile projector interfaces for uncovering task information embedded in physical environments.

22) Annapaola Marconi, Marco Pistore, Adina Sirbu, Frank Leymann, Hanna Eberle, and Tobias Unger

Enabling Adaptation of Pervasive Flows: Built-in Contextual Adaptation

Proceedings of the 7th International Joint Conference on Service Oriented Computing , 2009

DOI 10.1007/978-3-642-10383-4_33

Used by the ALLOW Ensembles project

Adaptable pervasive flows are dynamic workflows situated in the real world that modify their execution in order to adapt to changes in the execution environment. This requires on the one hand that a flow must be context-aware and on the other hand that it must be flexible enough to allow an easy and continuous adaptation. This paper proposes a set of constructs and principles for embedding the adaptation logic within the specification of a flow. Moreover, the authors show how a standard language for web process modeling (BPEL) can be extended to support the proposed built-in adaptation constructs.

23) Matthias Hözl, Axel Rauschmayer, and Martin Wirsing

Engineering of software-intensive systems: State of the art and research challenges

In Software-Intensive Systems and New Computing Paradigms, volume 5380 of LNCS. Springer.
<http://www.springerlink.com/content/j9124k700526jq63>

DOI: 10.1007/978-3-540-89437-7_1

Used by the ASCENS project

Surveying the state of the art of engineering of software-intensive systems, the authors point out the importance of location-awareness and context-awareness for autonomic systems.

24) Emil Vassev and Mike Hinchey

Knowledge Representation and Awareness in Autonomic Service-Component Ensembles – State of the Art

Proc. of the 14th IEEE International Symposium on Object/Component/Service-oriented Real-time Distributed Computing Workshops, 2011.

<http://www.computer.org/portal/web/csdl/doi/10.1109/ISORCW.2011.21>

Used by the ASCENS project

The paper addresses two interesting topics: knowledge representation and awareness, pointing out the connections between them. With regard to awareness, the interesting contribution of this paper is a formal model.

25) Simon Dobson and Spyros Denazis and Antonio Fernandez and Dominique Gaiti and Erol Gelenbe and Fabio Massacci and Paddy Nixon and Fabrice Saffre and Nikita Schmidt and Franco Zambonelli

A survey of autonomic communications

ACM Transactions on Autonomous and Adaptive Systems, 2006, V.1, N.2, pp 223—259

<http://dl.acm.org/citation.cfm?id=1186782>

DOI: 10.1145/1186778.1186782

Used by the ASCENS project

The paper concerns autonomic communications and points out in particular the importance of context-awareness. The latter, combined with adaptive behaviours, can represent the base of self-awareness.

26) Madhusudan Parthasarathy

Synthesizing Reactive Programs

20th Conference on Computer Science Logic (CSL), Bergen, Norway, 2011, pages 428-442

<http://www.cs.uiuc.edu/~madhu/csl11.pdf>

Used by the Cassting project

Current theoretical solutions to the classical Church's synthesis problem are focussed on synthesizing transition systems and not programs. Programs are compact and often the true aim in many synthesis problems, while the transition systems that correspond to them are often large and not very useful as synthesized artefacts. Consequently, current practical techniques first synthesize a transition system, and then extract a more compact representation from it. In this paper, the synthesis of reactive systems is formulated directly in terms of program synthesis. The problem of synthesizing programs over a fixed set of Boolean variables in a simple imperative programming language is proven decidable for regular specifications.

27) Yoad Lustig, Moshe Y. Vardi

Synthesis from Component Libraries.

12th International Conference Foundations of Software Science and

Computational Structures (FOSSACS), York, UK, 2009, pages 395-409

<http://www.cs.rice.edu/~vardi/papers/fossacs09.pdf>

Used by the Cassting project

Synthesis is the automated construction of a system from its specification. In the classical temporal synthesis algorithms, it is always assumed the system is constructed from scratch rather than composed from reusable components. This, of course, rarely happens in real life. In real life, almost every non-trivial commercial system, either in hardware or in software system, relies heavily on using libraries of reusable components. Furthermore, other contexts, such as web-service orchestration, can be modeled as synthesis of a system from a library of components. This work defines and studies the synthesis problem from libraries of reusable components. It considers two notions of composition: data-flow composition, for which the problem is undecidable, and control-flow composition, for which the problem is 2EXPTIME-complete. As a side benefit, an explicit characterization of the information needed by the synthesizer on the underlying components is obtained. This characterization can be used as a specification formalism between component providers and integrators.

28) Rajeev Alur, Thomas A. Henzinger and Orna Kupferman

Alternating-time Temporal Logic

Journal of the ACM 49(5), 2002, pages 672-713

http://pub.ist.ac.at/~tah/Publications/alternating-time_temporal_logic.pdf

Used by the Cassting project

Temporal logics are a very powerful formalism for expressing properties to be checked in a computerized system. They usually come in two varieties: linear-time temporal logic assumes implicit universal quantification over all paths that are generated by the execution of a system; branching-time temporal logic allows explicit existential and universal quantification over all paths. This paper introduces a third, more general variety of temporal logic: alternating-time temporal logic offers selective quantification over those paths that are possible outcomes of games, such as the game in which the system and the environment alternate moves. While linear-time and branching-time logics are natural specification languages for closed systems, alternating-time logics are natural specification languages for open systems. For example, by preceding the temporal operators with a selective path quantifier, one can specify in ATL that in the game between the system and the environment, the system has a strategy to achieve a certain goal. The problems of receptiveness, realizability, and controllability can be formulated as model-checking problems for alternating-time formulas. Model-checking ATL is linear in the size of the game structure and in the length of the formula.

29) Ocan Sankur, Patricia Bouyer, Nicolas Markey and Pierre-Alain Reynier

Robust Controller Synthesis in Timed Automata

24th International Conference on Concurrency Theory (CONCUR), Buenos Aires, Argentina, 2013, pages 546-560.

<http://www.lsv.ens-cachan.fr/Publis/PAPERS/PDF/SBMR-concur13.pdf>

Used by the Cassting project

Timed automata are a convenient model for representing real-time systems. However, their semantics is a mathematical idealization of physical systems, and the properties that hold true in a model might fail to hold in its implementations. Taking timing imprecisions into account is an important step towards a broader usability of timed automata in verification and synthesis. This paper considers the fundamental problem of Büchi acceptance in timed automata in a robust setting. The problem is formalised in terms of controller synthesis: timed automata are equipped with a parametrised game-based semantics that models the possible perturbations of the decisions taken by the controller. We characterise timed automata that are robustly controllable for some parameter, with a simple graph theoretic condition, by showing the equivalence with the existence of an aperiodic lasso that satisfies the winning condition (aperiodicity was defined and used earlier in different contexts to characterise convergence phenomena in timed automata). We then show decidability and PSPACE-completeness of our problem.

30) Michael Ummels, Dominik Wojtczak

The Complexity of Nash Equilibria in Stochastic Multiplayer Games

Logical Methods in Computer Science 7(3) (2011)

<http://arxiv.org/pdf/1109.4017>

Used by the Cassting project

This paper analyses the computational complexity of finding Nash equilibria in turn-based stochastic multiplayer games with omega-regular objectives. It shows that restricting the search space to equilibria whose payoffs fall into a certain interval may lead to undecidability. In particular, it is proved that the following problem is undecidable: Given a game G , does there exist a Nash equilibrium of G where Player 0 wins with probability 1? Moreover, this problem remains undecidable when restricted to pure strategies or (pure) strategies with finite memory. One way to obtain a decidable variant of the problem is to restrict the strategies to be positional or stationary. For the complexity of these two problems, the authors obtain a common lower bound of NP and upper bounds of NP and PSPACE respectively.

31) Joseph Y. Halpern

Beyond Nash Equilibrium: Solution Concepts for the 21st Century

In Krzysztof R. Apt, Erich Grädel: Lectures in Game Theory for Computer Scientists, 2011.

<http://arxiv.org/pdf/0806.2139>

Used by the Cassting project

Nash equilibrium is the most commonly-used notion of equilibrium for non-zero-sum games. However, it suffers from numerous problems. Some are well known in the game theory community; for example, the Nash equilibrium of repeated prisoner's dilemma is neither normatively nor descriptively reasonable.

However, new problems arise when considering Nash equilibrium from a computer science perspective: for example, Nash equilibrium is not robust (it does not tolerate "faulty" or "unexpected" behavior), it does not deal with coalitions, it does not take computation cost into account, and it does not deal with cases where players are not aware of all aspects of the game. Solution concepts that try to address these shortcomings of Nash equilibrium are discussed.

32) Dietmar Berwanger, Krishnendu Chatterjee, Laurent Doyen, Martin De Wulf and Thomas A. Henzinger

ALPAGA : a Tool for Solving Parity Games with Imperfect Information

15th International Conference on Tools and Algorithms for Construction and Analysis of Systems (TACAS), York, UK, 2009, pages 58-61.

<http://www.lsv.ens-cachan.fr/~doyen/papers/Alpaga.pdf>

Used by the Cassting project

Alpaga is a solver for two-player parity games with imperfect information. Given the description of a game, it determines whether the first player can ensure to win and, if so, it constructs a winning strategy. The tool provides a symbolic implementation of an algorithm based on antichains.

33) Algirdas Avizienis,

The N-Version Approach to Fault-Tolerant Software

IEEE Transactions On Software Engineering, Vol. Se-I 1, No. 12, December 1985

DOI [10.1109/TSE.1985.231893](https://doi.org/10.1109/TSE.1985.231893)

Used by the Diversify project

This paper is the seminal paper for N-version programming, the first implementation of software diversity for dependable embedded systems. This is a major piece of state of the art for DIVERSIFY and an essential motivation for diversity in the area of software engineering.

34) Jennifer A. Dunne, Richard J. Williams, Neo D. Martinez

Network structure and biodiversity loss in food webs: robustness increases with connectance

Ecology Letters Volume 5, Issue 4, pages 558–567, July 2002

DOI: [10.1046/j.1461-0248.2002.00354.x](https://doi.org/10.1046/j.1461-0248.2002.00354.x)

Used by the Diversify project

This paper proposes a metric for the robustness of relations in ecological network. The metric is based on different models of extinction for one level in the network and on the analysis of this extinction on other levels. DIVERSIFY adapts this metric to evaluate the impact of random failures and systematic attacks on software servers.

35) R. Feldt

Generating diverse software versions with genetic programming: an experimental study

IEE Proceedings Software, Volume: 145 , Issue: 6, 1998 , Page(s): 228 - 236

DOI [10.1049/ip-sen:19982444](https://doi.org/10.1049/ip-sen:19982444)

Used by the Diversify project

One of the first work to use genetic programming for the automatic generation of variants for N-version programming. Feldt was able to generate several variants for an embedded computer, which exhibit failure diversity, one essential assumption for the success of N-version programming.

36) Forrest, S. ; Somayaji, A. ; Ackley, D.H.

Building Diverse Computer Systems

The Sixth Workshop on Hot Topics in Operating Systems, 1997, 67 - 72

DOI 10.1109/HOTOS.1997.595185

Used by the Diversify project

Another seminal paper by Stephanie Forrest who advocates for increased diversity in operating systems, for security purposes. Even if this work addresses systems more than software concerns, it is an essential source for most of the work that automate the synthesis of diversity in software intensive systems. Forrest eventually went from this concept to artificial immune systems and instruction set randomization.

37) Michael Franz

E unibus pluram: Massive-Scale Software Diversity as a Defense Mechanism

NSPW '10: Proceedings of the 2010 workshop on New security paradigms, Pages 7-16

DOI 10.1145/1900546.1900550

Used by the Diversify project

Franz proposes to generate massive diversity through compilation, for security purposes. He identifies a number of paradigm shifts necessary for this massive diversification. This paper is a good conceptual overview for diversity synthesis and solid reference for the objectives of DIVERSIFY.

38) Kevin Shear McCann

The diversity–stability debate

NATURE, Vol 405, 11 May 2000

DOI 10.1038/35012234

Used by the Diversify project

This paper synthesizes the main elements in the debate that goes on in ecology to understand the exact role of biodiversity on the stability, resilience and productivity of ecosystems. DIVERSIFY's conceptual foundation is that diversity improves adaptation and resilience capacities of complex systems, in particular software systems. The paper by McCann is thus an essential foundation to understand all dimensions that must be taken into account to validate this assumption.

39) Carlos J. Melian, David Alonso, Diego P. Vazquez, James Regetz, Stefano Allesina

Frequency-Dependent Selection Predicts Patterns of Radiations and Biodiversity

PLoS Comput Biol 6(8): e1000892

DOI 10.1371/journal.pcbi.1000892

Used by the Diversify project

In this paper, Carlos Melian, a member of the DIVERSIFY ecological board, develops a neutral model (i.e., independent from the environment, based on purely stochastic birth/mate/death processes) for the evolution of species. This is a major influence for DIVERSIFY, which has led us to explore the possibility of having a neutral model of software evolution and its influence on diversity emergence and robustness of the system.

40) Brice Morin, Olivier Barais, Grégory Nain and Jean-Marc Jézéquel

Taming Dynamically Adaptive Systems Using Models and Aspects

IEEE 31st International Conference on Software Engineering, 2009. ICSE 2009, Pages: 122 - 132

DOI 10.1109/ICSE.2009.5070514

Used by the Diversify project

One diverse software variants are synthesized at different levels in software applications, it is necessary to disseminate and change them at runtime. DIVERSIFY relies on the models@runtime paradigm, introduced by Morin et al. in this paper.

41) Daryl Posnett, Raissa D'Souza, Premkumar Devanbu, and, Vladimir Filkov

Dual Ecological Measures of Focus in Software Development

2013 35th International Conference on Software Engineering (ICSE), San Francisco, USA, 2013, Pages: 452 - 461

DOI [10.1109/ICSE.2013.6606591](https://doi.org/10.1109/ICSE.2013.6606591)

Used by the Diversify project

Posnett et al. model commiter / project relationships in open source repositories as a bipartite graph and use metrics from ecology to analyze the graph. They analyze the role of expertise and focus in committers' activities on the quality of the software. This is a very recent and solid piece of software engineering literature, which is founded on ecological theoretical basis. However, the purpose is analytical rather than engineering, as is the case in DIVERSIFY.

42) Martin Rinard

Obtaining and Reasoning About Good Enough Software

DAC '12 Proceedings of the 49th Annual Design Automation Conference, June 3-7, 2012, San Francisco, California, USA, Pages 930-935

DOI [10.1145/2228360.2228526](https://doi.org/10.1145/2228360.2228526)

Used by the Diversify project

Martin Rinard has explored many different unsound program transformations that aim at slightly modifying the behavior of programs, in exchange of better performance or fault-resistance. An essential work of DIVERSIFY consists in synthesizing program variants that all exhibit the same visible behavior must implement diverse computation. This work is founded on unsound program transformations, in the same spirit as the work of Rinard.

43) Martin Rinard, Cristian Cadar, Daniel Dumitran, Daniel M. Roy, Tudor Leu, and William S. Beebee, Jr.

Enhancing Server Availability and Security Through Failure-Oblivious Computing

OSDI'04 Proceedings of the 6th conference on Symposium on Operating Systems Design & Implementation - Volume 6, Pages 21-21

http://static.usenix.org/event/osdi04/tech/full_papers/rinard/rinard_html/

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implement diverse computation. This work is founded on unsound program transformations, in the same spirit as the work of Rinard.

44) F. Giunchiglia, V. Maltese, B. Dutta

Domains and context: first steps towards managing diversity in knowledge

Journal of Web Semantics, special issue on Reasoning with Context in the Semantic Web, Vol. 12, 2012

<http://www.websemanticsjournal.org/index.php/ps/article/view/229>

Used by the SmartSociety project

This paper deals with diversity, a concept that is very interesting in the field of collective adaptive systems. In particular, the paper focuses on diversity in knowledge and on the contextualization of such a diversity.

45) L. Von Ahn

Games With A Purpose

IEEE Computer Magazine (2006), 96-98.

<http://dx.doi.org/10.1109/MC.2006.196>

Used by the SmartSociety project

Online games are a particular case of collective adaptive systems. Thanks to the evolution of the games by different, autonomous players, a behavior can emerge to carry out a purpose.

46) D. Schall, S. Dudstar, M. Brake

Programming Human and Software-Based Web Services

IEEE Computer, Volume 43 , Issue 7, Pages 82 – 85, 2010

<http://dx.doi.org/10.1109/MC.2010.205>

Used by the SmartSociety project

Human-in-the-loop is an interesting aspect of collective adaptive systems. In this paper, the field of web services is addressed, and the authors deal with the involvement of the humans.

47) J. H. Holland

Studying Complex Adaptive Systems

Journal of Systems Science and Complexity 19 (1): 1-8, 2006

<http://dx.doi.org/10.1007/s11424-006-0001-z>

Used by the SmartSociety project

Starting from the consideration that some of most powerful mathematical tools are of limited help in understanding the development of complex adaptive systems, this paper suggests ways to modify research methods and tools, with an emphasis on the role of computer-based models, to increase our understanding of complex adaptive systems.

48) P. Brown, H. Lauder

Human Capital, Social Capital and Collective Intelligence

In: Baron, S., Field, J. and Schuller, T., eds. Social Capital: Critical Perspectives. Oxford: Oxford University Press, pp. 226-242. Collective intelligence, 2001

<http://opus.bath.ac.uk/17728/>

Used by the SmartSociety project

This paper presents an interesting social point of view, the collective intelligence, which can be exploited in the modelling of collective adaptive systems.

49) R. Albert, H. Jeong and A.-L. Barabási

Error and attack tolerance of complex networks

Nature 406, 378-382, 2000

<http://www.nature.com/nature/journal/v406/n6794/full/406378a0.html>

Used by the SmartSociety project

Resilience is an interesting feature for collective adaptive systems. This paper presents a study about resilience in complex networks. The term resilience is used to denote the ability to reduce the magnitude and/or duration of disruptive events on the system. It relates to the systemic capability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event.

50) N. Nisan, T. Roughgarden, E. Tardos, and V. Vazirani

Algorithmic Game Theory

Cambridge University Press, 2007

http://www.cambridge.org/journals/nisan/downloads/Nisan_Non-printable.pdf

Used by the SmartSociety project

Game theory proposes a lot of useful approaches to model and manage the dynamics of collective adaptive systems.

51) Y. Shoham, K. Leyton-Brown (2009).

Multiagent Systems: Algorithmic, Game Theoretic and Logical Foundations

Cambridge University Press, 2009

<http://www.masfoundations.org/mas.pdf>

Used by the SmartSociety project

Multiagent systems are a specific case of collective adaptive systems; in fact, their sociality leads to be a collective set of autonomous entities; their proactiveness allows them to adapt to unpredictable situations. This field presents a valuable experience that can be exploited and reused for other kinds of collective adaptive systems.

52) T. Bynum

The Foundation of Computer Ethics

ACM SIGCAS Computers and Society, 30:2. 6 – 13. New York: ACM, 2000

<http://dl.acm.org/citation.cfm?id=572230.572231&coll=DL&dl=ACM&CFID=625842967&CFTOKEN=66608826>

Used by the SmartSociety project

In developing adaptive systems that will exhibit emergent behaviors, a particular attention must be paid to ethics. In this paper, the author proposes the foundation of the ethics related to computer world.

53) M. Naphade, G. Banavar, C. Harrison, Jurij Paraszczak, and Robert Morris

Smarter Cities and Their Innovation Challenges

In IEEE Computer, Vol. 44, Issue 6, 32-39, 2011

http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5875937&tag=1

Used by the SmartSociety project

Smart cities are one of the most interesting case studies for research on collective adaptive systems. This paper presents ongoing projects around the world and illustrates the opportunities and challenges of the transformation from “traditional” cities to “smart” cities.