SIGEVOlution

newsletter of the ACM Special Interest Group on Genetic and Evolutionary Computation

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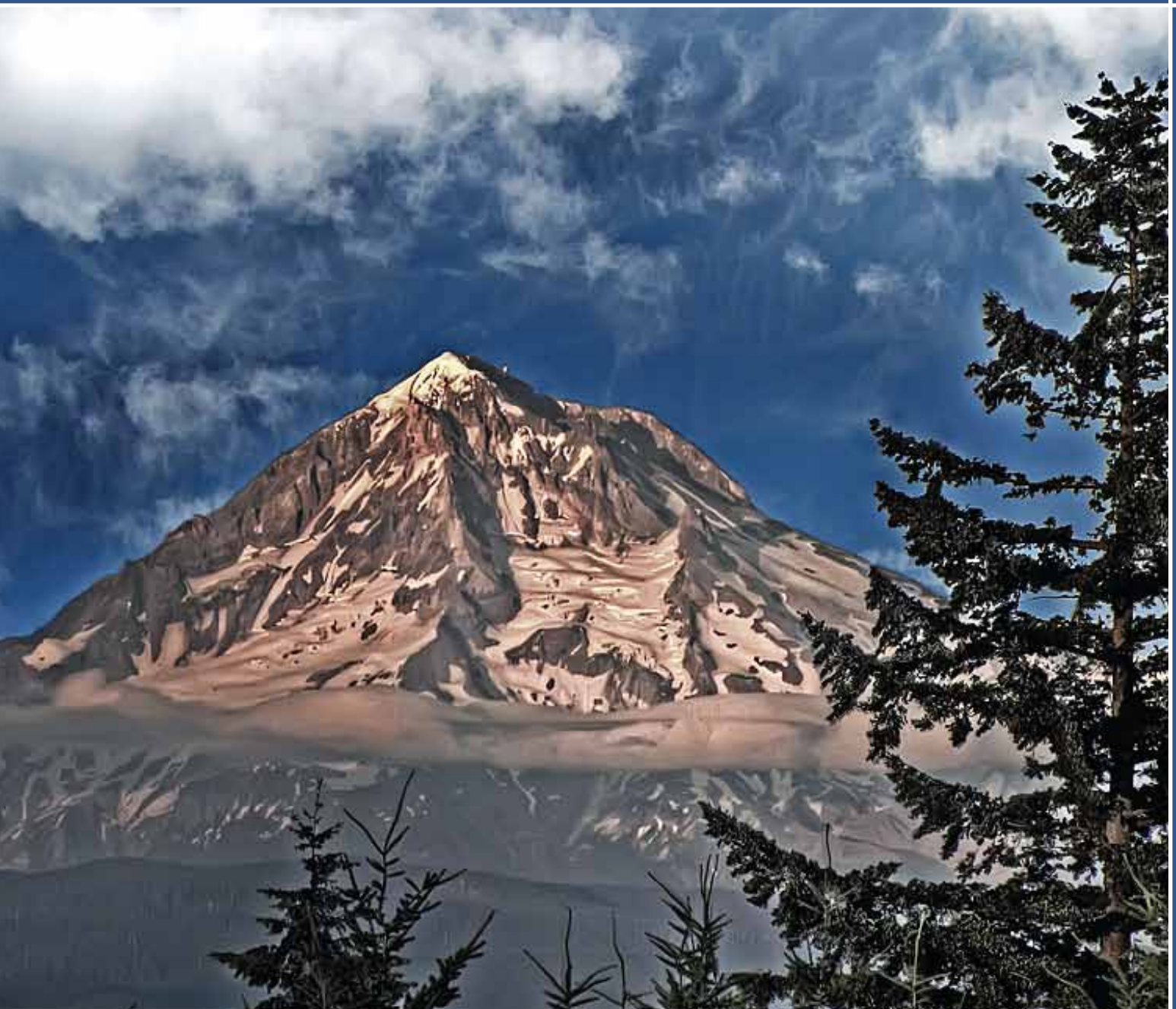

in this issue

Editorial

Happy new year! Or should I say Happy Deadline Extension? Fifteen days more to prepare the submission for GECCO-2010 are possibly the best way to start the new year. While you are writing, the organizing committee is finalizing the list of tutorials and workshops which now includes 13 workshops and 32 tutorials. Wow!

To me, going to GECCO feels like when there are too many good movies on TV: I don't know which one to watch so I desperately hope for reruns. Luckily, SIGEVO is actually working to provide us with our own reruns. During GECCO-2009, the keynotes and some of the tutorials were recorded and will soon be available through the ACM Digital Library (another good reason to renew your ACM/SIGEVO membership). And the GECCO-2010 committee is currently working to have more recordings this year.

Do you know the Genetic Argonaut Blog? You definitively should. Recently, the blog hosted an interesting post entitled "Evolutionary Computation Classics - Vol. I" that presents a brief overview of the history of Evolutionary Computation. The blog also hosted an interview with Hans-Paul Schwefel for the 45th anniversary of Evolution Strategies, published around the same time our interview came out. When I read it, I thought it was very interesting and thus I asked Hans-Paul Schwefel and Marcelo Augusto de Brito Mendes (aka the Genetic Argonaut) to host the interview also in the newsletter. So here it is!

Finally, if you want to read about some nice applications of evolutionary computation to games, I suggest you read the report of the 2009 IEEE Symposium on Computational Intelligence and Games and check the proceedings freely available on-line.

As always, I owe my thanks to the many people who helped me in this: Hans-Paul Schwefel, Marcelo Augusto de Brito Mendes, David Robles, Luigi Cardamone, Mike Preuss, Martin V. Butz, Xavier Llorá, Kumara Sastry, Cristiana Bolchini, Mario Verdicchio, Viola Schiaffonati, and board members Dave Davis and Martin Pelikan.

Remember: the deadline for submissions is January 27th 2010, almost one week away. If you wish to add a note to your calendar, just follow this link, while if you wish to keep yourself updated, you should check the GECCO-2010 Twitter page at http://www.twitter.com/GECCO2010.

The cover is a night photo of Mount Hood, the tallest mountain in Oregon, by David Gn.

Pier Luca
January 18th, 2010

SIGEVOlution Volume 4, Issue 2

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Contributors to this Issue

Hans-Paul Schwefel
Marcelo Augusto de Brito Mendes
Luigi Cardamone
David Robles

Contents

45 Years of Evolution Strategies

Hans-Paul Schwefel Interviewed for the Genetic Argonaut Blog

Hans-Paul Schwefel, Universität Dortmund, hps@udo.edu
Marcelo Augusto de Brito Mendes (aka The Genetic Argonaut), swarm_of_ants@yahoo.com.br

June 12th 2009 has been the 45th anniversary of an evolutionary algorithm: Evolution strategies.

So, to celebrate this, somehow, important date to evolutionary computation, I have made a brief interview with Professor Hans-Paul Schwefel concerning what the "unofficial" Arbeitsgruppe Evolutionstechnik had to overcome during the creation of this new optimization procedure. The questions focused on the period before, during, and after the innovation process that brought evolution strategies into life and how he sees the contemporary approaches being used. Here you are the interview.

By the way, I would like to invite you to read the new and much improved post Evolutionary Computation Classics - Volume I, that tells the long version of the story below.

I hope you enjoy it!

Marcelo Augusto de Brito Mendes
The Genetic Argonaut

Q Could you tell us a little about growing up in post WWII Germany and your high school later years at Canisius College? What kind of student were you? Did your daily life orbit around school-home and home-school?

School went smooth without any problems and without highlights until October 4th, 1957 (launch of the first artificial earth satellite 'Sputnik 1'). From then on, I wanted to become astronaut and became one of the best pupils, especially in maths. I had also lessons in playing the violin, was member of the school orchestra and the school choir, but more important for me were the actions as a boy scout, where I was urged to play a leader's role, very soon - until I needed more time for studying. By the way, I needed 90 minutes each per day for the way to and from highschool (class 6 to 13).

Q Why did you choose aerospace technology engineering as your undergraduation degree? Did the brain drain Germany faced (e.g., Operation Paperclip) have any influence on your decision?

Why? - see above! I was not aware of the brain drain (at least I don't remember) and due to my family's financial situation studying away from home was unthinkable.

Q When you were admitted at the Technical University Berlin (TUB), during your initial semesters, you had any (at least the vaguest) idea of working with computers and simulation in general?

No, since there were only mechanical calculators operated by means of a rotatable handle, at that time. The first available computer (in the basement of the institute of mechanics) became 'mine' during night times for my diploma thesis' simulation experiments.

Q Before joining in TUB's Hermann Föttinger-Institute for Hydrodynamics (HFI), had you already heard of your evolution strategies fellows (Ingo Rechenberg and Peter Bienert)?

No. I became engaged by invitation from the Head of the institute, because I was his best student (two times best marks in written exams).

Q How did you end up working at TUB's Hermann Föttinger-Institute for Hydrodynamics (HFI)? What was the academic feeling/environment there?

Besides of my duties, i.e. preparing and controlling other students' experiments, I spent much time with Ingo Rechenberg and later also Peter Bienert in performing 'our' work - until all of us were relegated, being said: "Cybernetics as such will no longer be done at this institute".

Q Was the idea of experimental optimization a well known practical method during 1960s engineering Zeitgeist or was it seen as an exotic way of doing research? What did the well established professors at HFI think about that?

The traditional way - as we saw it - was a sequence of creating hypotheses from first principles and known facts plus experiments to prove or falsify the hypotheses. Iteratively improving facilities or processes systematically was rare, though there was some literature about the 'design and analysis of experiments'. Our first successes were highly accepted and even mentioned in the press, but the established experts in the field of hydrodynamics were skeptical or even hostile. Thus we were forced to go back to traditional work or to leave.

Q Can we say the 1960s optimization Zeitgeist was all about linear and non-linear programming? Were gradient-based methods the archetype optimization methods of that time?

Exactly! Optimization methods were a topic of numerical maths. Some opponent said: "We've got the optimal optimization method already..." (he meant steepest descent/ascent) "...and need no more".

Q What were your initial feelings after seeing the results of the experimentum crucis? At least in essence, does that experiment share some features with the modern evolution strategies? To whom the Arbeitsgruppe Evolutionstechnik reported the feedbacks got from that experiment? Could we consider the experimentum crucis the first evolvable hardware experiment ever made?

The first ES version operated with just one offspring per 'generation' because we did not have a population of objects to operate with. I termed it later (1+1)-ES in order to distinguish it from 'multimembered' versions. And we used discrete mutations in the vicinity of the parent's position. In my diploma thesis'(1964/65) work I demonstrated that such more or less local strategy can get stuck prematurely. Therefore I proposed to use probability density distributions like the gaussian one for continuous variables. But we were proud of having shown that the simple ES worked under noisy and (perhaps) multimodal conditions, whereas one-variable-at-a-time and gradient methods failed.

And the simple ES was much more efficient (quick) than opponents had predicted. Their (sometimes even now maintained) misconception was to think of uniformly distributed mutations in the whole search space.

But: There was no proof of convergence nor any theory of the efficiency. Rechenberg's PhD. thesis from 1971 contained the first efficiency results, i.e. the local velocity of the (1+1)-ES in n dimensions of two fitness landscapes.

The first evolvable hardware was created with Peter Bienert's diploma thesis as FORO 1, the first research robot (FOrschungsROboter) able to handle several step motors calibrating, e.g., potentiometers at some mechano-electric facility (actually a hybrid computer acting on a pneumatic control device). That was also around 1970.

After the relegation from the institute of hydrodynamics in 1966, I earned my money at industry until 1970 (where I did the nozzle experiments), whereas Ingo Rechenberg and Peter Bienert settled (without salaries) at another institute of the Technical University of Berlin. There we met again after I got a grant from the German research foundation for work on comparing ES with other numerical optimization strategies on a digital computer. That money reached from 1970 to 1975 (I finished 'my book' in 1974, which was accepted as dissertation, the defense of which took part only in 1975). Besides of both theses of ours there were no further publications between 1965 and 1971 since too much time went into writing grant proposals and struggle for survival (except an article of mine in my school's yearbook of 1966 and the frequent technical reports for the grant giving authority, i.e. unpublished work).

Once I saw some slides from a presentation delivered by Professor Rechenberg in which a Galton Box (or bean machine) was shown. Was that device used as the mutation operator for the experimentum crucis? Galton boxes may have different distribution/density probability functions (depending on the manner the user set it up), what was the distribution/density function of the box used by the "unofficial" Arbeitsgruppe Evolutionstechnik?

The Galton box was used for demonstration purposes only. Actually, we used some kind of children's playing chips with a plus sign on one side and a minus sign on the opposite side.

In the simplest case with two chips the result could be:

- ++ with probability 1/4 for changing a variable in positive direction, or;
- – also with probability 1/4 for changing a variable in negative direction, or;
- +- (or -+) with probability 1/2 for no change.

With more chips one could of course produce broader binomial probability distributions.

What did the judge board think about your senior thesis (undegraduation final project)?

I got the highest mark for that work (I had written the task's requirement myself, which was accepted by the Head of the fluid dynamics institute). Ingo and me got our diplomas at the same time together with a prize from the German Association of Engineers (VDI) for the best 3 students of the year 1965 (Ingo being 6 years, or 12 semesters, older than me).

Q After graduating, you did not join in (right away) a MSc. course or something similar, but went to work repairing Lockheed Super Constellation aircrafts coming back from South America. Didn't you think it was a (somehow) "ungrateful" work compared to all the experimental optimization and computer simulation work you had performed at TUB some few years (months?) earlier?

To put things in right order, my times studying at the TU Berlin required not only at least 10 semesters of topical lectures and exercises with exams, but in addition to that 12 months of practical work (internships), 6 of which had to be completed before entering the first semester, the other 6 in between the following 11 terms, plus studies with exams in 4 non-technical domains like philosophy, laws and economics, arts and foreign languages. It was during the 6 months between the semesters that I joined Lufthansa's dockyards at Hamburg and had to do with Lockheed's SuperConstellations. I also joined a team of specialists concerned with oxygen/hydrogen rocket motors (later on used for Ariane missiles' position control motors) at Boelkow's company near Munich as well as a helicopter jet engines factory (Turboméca) in Southern France.

In Germany there was not such a sharp split between undergraduate and graduate studies. One had to pass a series of exams after about half of the time (the 'Vordiplom') but one could not yet get a job with only that part of the 'basic' studies, normally. For clarity, here is a schedule of mine:

1959 highschool ended, 6 months internship, beginning of studies (after I had in vain tried to get a pilot school place at Lufthansa - the school was closed that year, the only reason why I tried to bridge the gap by joining the university)

1959-1965 Studies in aero- and space technology with emphasis on propulsion and further 6 months internships and 'humanistic' studies in between. 1965-1966

Coworker at the institute of hydrodynamics (full paid work for studies in turbulent wall shear stress measurement techniques - together with Ingo Rechenberg ((ES things were done aside and not paid for)))

1967-1970 Work at industry (AEG research group Berlin, concerned with work on some kind of liquid metal driven energy converter without rotating parts; the flashing nozzle being one essential part of it) 1970-1975 grants from the German research foundation (DFG) for self-defined work, two professors had to serve (better non-serve) as supervisors - a biologist and a control and measurement scientist (Ingo Rechenberg became professor himself by a transition rule in the reorganisation of the university, saying that all people with a high grade Ph.D. exam should be some kind of lower-grade professors; that was around 1973/74 when his dissertation became published as a book).

1976-1985 First 1/2 year on a grant from a research project at Hanover, for which I developed a model of non-genetic variance among cloned guinea pigs; then work in Juelich between Cologne and Aachen in the nuclear research centre (KFA) as systems analyst in a working group doing simulation models of the whole energy system (demand, conversion, consumption with all kinds of energy carriers) in Germany, the European Union and beyond.

1985- Professor at a new chair of systems analysis (applied computer science) at the (now also Technical) University of Dortmund - gained for my experience in systems analysis, not evolutionary computation.

Q The two phase flashing nozzle experiment is an interesting example of evolutionary optimization, do you think it would be a practical idea to apply the same approach (or a computer assisted one) to larger nozzles, such as those employed in aerospace industry/research?

One-component one-phase nozzles are theoretically well established and can be designed easily by means of known physical laws. Two-component nozzles (e.g., gas and solid particles in the flow) are a bit more difficult to design due to the shear stresses between fast fluid and slower particles, but there is a lot of empirical knowledge, now.

The problem with 'my' one-component two-phase case suffers additionally from non equilibrium thermodynamics of the phase transition from liquid to a mix of steam (fast) and liquid droplets (slow, also tending to cluster on walls and thus losing their energy content). I think that even now nobody is able to simulate these processes with boiling delay and supersonic shocks in the divergent part of the nozzle in order to optimally design such a flashing nozzle by means of CFD (computational fluid dynamics). But hot water rocket users might make use of my experiences. I tried to correspond with them - they not even answered a line.

Q Basically, what was the core of your work at AEG and KFA Jülich? Were there many opportunities of applying evolutionary computation in their problems?

After my success with the nozzle I was urged to manage a larger project, so that I tried to escape from such non-scientific work as soon as possible. After work I met Ingo Rechenberg and Peter Bienert at their site (control and measurement institute) and hoped for success of my grant application.

Q What was the main subject of your PhD./Dr.-Ing, thesis?

Comparison of Evolution Strategy (ES) with traditional numerical optimization methods, including improvements of ES (e.g., self adaptation of internal parameters, which lead to the later standard (μ, λ) versions), and trying to enhance theoretical analyses.

Q We may consider the years of 1964-1970, at large, as an early developmental and test of concept period for evolution strategies. How would you qualify (for evolution strategies) the subsequent decade, that is, the 1970s? Could we say it was during this decade the self-adaptation mechanism took place?

Exactly. But in 1976 I turned away because such work did not pay, and I became some kind of futurologist at Juelich.

Q After being admitted at Dortmund University as a full professor, what was the main aim your group set up for further research in evolutionary computation and how do you evaluate the results achieved?

I smuggled evolutionry algorithms' ideas into the subchapter 'optimization' in my courses on systems analysis, not forgetting to mention my experiences. It took not long until one and then more and more of my students became interested in just that part of the general topic. For them I tried to get money from research grants, and after 15 years the team had grown up to more than 30 coworkers.

Q Do you consider the genetic algorithm researchers switching from the traditional binary string representation and well known evolutionary operators approach to the estimation of distribution algorithms a (somehow) step toward an ES-like approach, since there is a (somehow) similarity between those algorithms when it comes to probability density/distribution function parameter(s) adaptation?

As always, I argue that any idea improving robustness and/or efficiency (at best: both) of an optimization algorithms is welcome. But, my personal interest (and at least at the beginning also Ingo's) has been in understanding and making use of real nature's tricks, too.

That is why arithmetic tricks not resembling natural processes are of a bit lesser interest to me. Artificial immune systems, ant colony optimization, differential evolution and many other approaches will have their specific domains and a practitioner would be stupid not to have all of them - including traditional methods -in his toolbox.

My experience is that even in one successful run to an optimum it may be necessary to switch between methods and to set some parameters anew by hand, as well.

Q What is your view upon derandomization approaches? Wouldn't it be better to keep some "noise" along the evolution optimization process rather than biasing it towards a "direction"?

All of that may be helpful or stupid depending on the specific situation. Noise hampers in 'easy' cases, but helps sometimes in more difficult ones. A good strategy adapts its internal parameters during the search, e.g., the main direction. I call these parameters 'internal model' of the corresponding individuals and found that it is important to maintain diversity of those internal models' within the population. I am dreaming of an evolutionary algorithm that comprises many more internal parameters self-adjusting during the search.

Q Along the history of evolution strategies we can see an addition process of new features (multi-individual population, self-adaptation, variances and covariances, and so on) and these features have became a standard in evolution strategies. When seeing others' approaches, such as genetic algorithms (and the almost forgotten evolutionary programming), we don't verify the same phenomenon, since the most applied genetic algorithm (elitist SGA) are practically the same one established by Kenneth De Jong during the early 1970s, even though there were and there have been well-intentioned works to add new features to genetic algorithm, but they have not became a GA standard. In your opinion, why did that happen in, for example, genetic algorithms' field?

In some cases simple versions are good enough, in some cases people are not even aware of traditional approaches. Sometimes people follow the advice of prophets without reading the bible, and prophets often simplify to spread their message.

The problem of problem solving is multifaceted: First, there is not enough theoretical foundation of the cause/effect relations in optimum seeking methods under various conditions. Second, black box situations (those for which evolutionary algorithms MAY be used) are not classified, perhaps not classifiable. Therefore unpredictability prevails, surprises are common, and convergence to the (a) global optimum within a manageable time cannot be guaranteed. In practice, being better than the competitors is sufficient - for a while.

Thus, even slight improvements towards a (perhaps moving) optimum are appreciated, only theoreticians remain dissatisfied.

Q After forty five years of evolution strategies, what are your impressions for the next forty five?

I cannot forecast. Curiosity prevails — and satisfaction.

About the author

Marcelo Augusto de Brito Mendes, well-known for his blog, the Genetic Argonaut, earned his computer engineer degree from UFPA (Universidade Federal do Pará, Brazil) where he studied artificial intelligence under the supervision of professor Eurípedes Pinheiro dos Santos. His main interests are evolutionary computation, neural networks, time series, and the use of evolutionary approaches in general problems.

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Events Reports

The 2009 IEEE Symposium on Computational Intelligence and Games (CIG-09)

Luigi Cardamone, Politecnico di Milano, Italy
David Robles, University of Essex, UK
Conference webpage: http://www.ieee-cig.org/cig-2009/

Overview of CIG-2009

The 2009 IEEE Symposium on Computational Intelligence and Games was held in Milan, Italy, September 7-10 2009. The event brought together leading researchers from academia and industry to present recent advances and to explore future directions in the application of computational intelligence techniques to games.

The conference was sponsored by the IEEE Computational Intelligence Society and took place at the Politecnico di Milano. This year, 76 papers from all over the world were submitted and 52 were accepted for presentation and publication in the proceedings. The presentations covered a wide range of topics including Evolutionary Computation, Neural Networks, Machine Learning, etc. The conference program also included four keynotes, two tutorials and five competitions.

The conference also received donations from Microsoft Research Cambridge, Milestone, NVidia and 2K Australia, demonstrating the support of game-related companies to the academic computational intelligence (CI) community.

Key notes and Tutorials

The conference opened with the tutorial "Practical issues in Evolving Neural Network Controllers for Video Game Agents" by Kenneth O. Stanley (University of Central Florida), the inventor of the popular NEAT and HyperNEAT algorithms for evolving complex artificial neural networks. Stanley showed how to evolve a robot army in the game NERO, by tuning the artificial brains of team members to perform challenging tasks, such as learning to surround walls to get to a goal, to avoid damage, and many other tasks.

James M. Vaccaro (Lockheed Martin) gave the second tutorial titled "Modeling a Simulation Framework of Real Urban and Board Games to Train Players". The tutorial discussed (i) a modeling approach for generating an urban terrain model from a Compact Terrain DataBase (CTDB) for computer-simulation of an urban search and rescue operation; (ii) a modeling approach for implementing the game RISK and generating autonomous players; (iii) a generalized implementation strategy for integrating both models into an autonomous dynamic planning and execution framework for gaming simulations; and (iv) an evolutionary strategy for using autonomous simulation results to improve player's abilities.

Later on, Stefano Lecchi (Milestone) gave the first keynote, titled "Artificial Intelligence in Games" regarding the behavior of non-player characters in racing games from his experiences in the game industry. He stated that in racing games the challenges for the development of a successful artificial intelligence (AI) in a commercial game translate into the programming of an AI which can adapt to the driving styles and to the driving capabilities of human players so as to improve their gaming experience. In addition, he pointed out that in racing games the behavior of non-player characters should be plausible, challenging throughout the game, adaptive, and that it should also lead to realistic group behaviors.

Yngvi Björnsson (Reykjavik University, Iceland) gave an excellent keynote about the state-of-the-art of General Game Playing (GGP) systems. The aim of GGP is to create intelligent agents that can automatically learn how to play a wide variety of different games at an expert level without any game-specific knowledge being provided by their developers. He discussed his Simulation-Based General Game Player, CADIAPLAYER, which proved its effectiveness by winning the 2007 and 2008 Association for the AAAI GGP competitions using Monte Carlo simulations for its move decisions.

The keynote also included different design models, and discussed some open research challenges that GGP poses for artificial intelligence sub-disciplines, such as knowledge representation, agent-based reasoning, heuristic search, computational intelligence, and machine learning.

David Stern (Microsoft Research Cambridge, UK) gave an exciting keynote about the Computation Intelligence techniques deployed in some Microsoft commercial games. Initially, he focused on the application of reinforcement learning to fighting games. Then, he discussed how imitation learning has been applied in Forza Motorsport where the player can train a Drivatar (based on his own driving style) which can replace the player in less interesting tracks. The keynote ended with a presentation of skill matching techniques which can increase the challenge in on-line multi-player matches of Halo 3.

Presentations

As in past years, several interesting works have been presented covering all the aspects of the Computational Intelligence and Games field.

From the one hand, robust and mature techniques have been applied to last generation computer games like Unreal Tournament, Quake, TORCS and several Real Time Strategy games, showing that Computational Intelligence has great potentialities also from the point of view of the game industry. On the other hand, more theoretical works focused on the technique itself, and applied improved or even new approaches to standard benchmarks like Pac-Man or well-known board games that provide a more accurate comparison with previous works.

Many works focused on the evolution of non-player characters but also new and interesting directions were introduced including imitation learning, game testing, measuring player experience, player modeling and automatic game content generation.

As usual, the proceedings are freely available on-line from the CIG-2009 website (http://www.ieee-cig.org/cig-2009/Proceedings/) while the papers from the previous events are available at the webpage of the CIG conferences (http://www.ieee-cig.org/).

Competitions

The conference included five competitions which gathered great interest in the community and received many submissions.

The Defcon competition was carried out for the first time in CIG. Defcon is a strategic game like RISK and the aim of the competition is to develop the best Defcon bot. Each bot played 30 matches against each other bot in a series of one-on-one matches with bots playing in each of the possible starting territory configurations. The game run on a limited-information mode (i.e., bots cannot see units hidden by the fog of war) and for each match, the resulting score was recorded for each player. In the end, the player with the highest cumulative score wins.

The 2K Botprize was carried out for the second time in a CIG event. The aim of the contest was to test whether a computer game playing bot could play like a human in a First Person Shooter. In the contest, bots tried to convince a panel of expert judges that they were actually human players. None of the bots were able to fool enough judges to take the main prize (7000 australian dollars!), but all the bots fooled at least one of the judges. The most human-like bot was sqlitebot by Jeremy Cothran and the joint runners up were anubot from Chris Pelling and ICE-2009 from the team from Ritsumeikan University, Japan.

The Ms. Pac-Man competition consisted on developing an agent controller that plays Ms. Pac-Man. The agent's input was the stream real-time video output from the original game (i.e. the agent did not have access to any details of the software platform). The aim of the Ms. Pac-Man agent was to score as many points as possible; the winner was the agent that achieved the highest score over ten runs each. There were four functioning entries submitted by the deadline, and the winning team was ICE Pambush 3, by Hiroshi Matsumoto, Takashi Ashida, Yuta Ozasa, Takashi Maruyama, and Ruck Thawonmas (Ritsumeikan University, Japan), with a new screen capture software agent Ms Pac-Man world record of 30,010 points! This run was performed live during the Ms. Pac-Man competition session at the conference, and was exciting to watch, with the entry surviving many seemingly impossible situations.

The simulated car racing competition of CIG-2009 was the final event of the 2009 Simulated Car Racing Championship, an event joining the three competitions held at CEC-2009, GECCO-2009, and CIG-2009. The aim of the competition was to develop a controller capable of racing against other opponents in three unknown tracks. This leg of the championship was won by Martin V. Butz and Thies D. Lönnecker while Enrique Onieva and David E. Pelta won the championship.

The results demonstrated that, in last year, the quality of the submissions had strongly improved: the controllers presented several complex behaviors (driving, overtaking, recovery, etc.) and also techniques to dynamically optimize some parameters during the race.

The Mario AI Competition consisted in controlling the Mario character through a series of levels. The competition received 15 submissions and Robin Baumgarten was the winner with an approach based on A*. The other submissions showed a variety of techniques: evolutionary computation, modular architectures, rule based architectures and neural networks.

Finally, some of the submissions of the different competitions resulted in 6 high quality papers showing that competitions are powerful means to push in some promising research directions.

Best Paper Award

The committee assigned two awards, one for the best paper and one for the best student paper. The best paper award was assigned to Erin Hastings, Ratan Guha and Kenneth Stanley for their paper "Evolving Content in the Galactic Arms Race Video Game". The best student paper award went to Jacob Schrum for the paper "Evolving Multi-modal Behavior in NPCs" he co-authored with Risto Miikkulainen.

Social Event

There was an excellent conference dinner that gave everyone a good opportunity to meet up after the first three days of the event. The dinner took place at Cantina Piemontese, a traditional Italian restaurant near the Duomo where the attendees had a great time while enjoying from the delicious Italian cuisine and wines. At the end of the dinner the IEEE Vice President for Conferences, Garrison Greenwood, talked very pleased about the outstanding organization of the conference, the progress of the CIG conferences thus far, the successful launch of the recently created IEEE Transactions on Computational Intelligence and AI in Games, and about the things to come for this research community.

Conclusions

CIG-2009 was a great experience and we look forward to the next edition, CIG-2010, that will take place in Copenhagen, August 18-21, 2010.

Dissertation Corner

Generative Fixation: A Unified Explanation for the Adaptive Capacity of Simple Recombinative Genetic Algorithms

Doctoral Thesis by Keki M. Burjorjee

Simple genetic algorithms have been used in a wide range of engineering and scientific fields to quickly procure useful solutions to poorly understood optimization problems. Unfortunately, despite the routine use of these algorithms for over three decades, their remarkable adaptive capacity has not been adequately accounted for. In my dissertation, I develop, submit, and support the *generative fixation hypothesis*—a unified explanation for the adaptive capacity of the simple genetic algorithm.

The generative fixation hypothesis is based on the inference of a close relationship between the simple genetic algorithm and a promising general-purpose stochastic search heuristic, called *hyperclimbing*, for optimizing over attribute product spaces (e.g., the set of all binary strings of some fixed length) with rugged fitness functions. Hyperclimbing works by progressively limiting sampling to a series of nested schemata of increasing order, and increasing expected fitness. At each step, this heuristic searches through vast numbers of coarse partitions of the schema it “inhabits", and identifies ones that partition this set into schemata whose expected fitness values are significantly variegated. Because hyperclimbing is sensitive, not to the local features of a search space, but to certain more global statistics, it is not susceptible to the kinds of issues that waylay local search heuristics.

The chief barrier to the wide and enthusiastic use of hyperclimbing is that it seems to scale very poorly with the number of attributes. When one heeds the seemingly high cost of applying hyperclimbing to large search spaces, this heuristic quickly looses its shine. A key conclusion of my dissertation is that this seemingly high cost is illusory. I present evidence that strongly suggests that the simple genetic algorithm can implement hyperclimbing extraordinarily efficiently.

I compare the generative fixation hypothesis with the building block hypothesis and argue that the former surpasses the latter on three counts:

1. The former hypothesis can account for the adaptive capacity of a wider class of simple genetic algorithms. This class includes simple genetic algorithms that use uniform crossover.
2. The former hypothesis presumes less about the distribution of fitness over the chromosome set. It does not, for example, presume the existence of a hierarchy of building blocks.
3. The former hypothesis can successfully pass a demanding test of validity, one involving the application of a simple genetic algorithm with and without a mechanism called *clamping* to large, random instances of MAXSAT.

In breaking from the building block hypothesis, the generative fixation hypothesis reverts back to two classic positions in population genetics:

1. That fixation is the vehicle by which adaptive gains are secured.
2. That the function of recombination is to prevent hitchhiking.

On a third matter, that of the unit of selection, the generative fixation hypothesis is at odds with the position taken by orthodox neo-darwinists, which is that the unit of selection in an evolving population is always reducible to the unit of inheritance—that the gene, in other words, is the ultimate unit of selection. In contrast, the generative fixation hypothesis holds that the unit of selection can be a small irreducible set of unlinked or weakly linked genes. This difference between the two theories has crucial computational implications which I highlight.

Keki Burjorjee received his A.B. in computer science and mathematics in 1998 from Vassar College, and his M.A. and Ph.D. in computer science in 2004 and 2009, respectively, from Brandeis University. From 2000 to 2002 he was a graduate student in the Brain and Cognitive Sciences Department at the University of Rochester, where he studied computational neuroscience. He is fascinated by the unconventional ways in which biological systems—specifically neural and evolutionary systems—compute, and seeks to identify the core computational efficiencies that underlie the remarkable adaptive capacities of such systems. Towards this end he has developed a new technique for discovering such efficiencies; the technique involves the exploitation of algorithmic symmetry and the use of monte-carlo sampling. His larger goal is to use the discovered computational efficiencies to surmount some of the seemingly insurmountable challenges that computer scientists currently face when engineering large-scale adaptive systems.

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Calls and Calendar

March 2010

4th Workshop on Theory of Randomized Search Heuristics (ThRaSH'2010)

March 24-25, 2010, Paris, France

Homepage: http://trsh2010.gforge.inria.fr/

Deadline for abstract submission: February 8, 2010

Registration deadline: March 5, 2010

Following the workshops in Wroclaw, Poland, Dortmund, Germany, and Birmingham, UK, the 4th workshop on Theory of Randomized Search Heuristics (ThRaSH'2010) will take place in Paris on the 24th and 25th of March 2010. The purpose of the workshop is to address questions related to theory of randomized search heuristics such as evolutionary algorithms, ant colony optimization, or simulated annealing for both combinatorial and numerical optimization. The primary focus lies on discussing recent ideas and detecting challenging topics for future work, rather than on the presentation of final results.

Researchers working on theoretical aspects of randomized search heuristics are invited to submit a short abstract (one single page) by email to "thrash2010@lri.fr". No registration fee will be charged but participants are asked to register before the workshop.

April 2010

Evostar 2010 - EuroGP, EvoCOP, EvoBIO and EvoWorkshops

April 7-9, 2010, Istanbul Technical University, Istanbul, Turkey

Homepage: www.evostar.org

Deadline November 11, 2009

The EuroGP, EvoCOP, EvoBIO and EvoApplications conferences compose EVO*: Europe's premier co-located events in the field of Evolutionary Computing.

Featuring the latest in theoretical and applied research, EVO* topics include recent genetic programming challenges, evolutionary and other meta-heuristic approaches for combinatorial optimisation, evolutionary algorithms, machine learning and data mining techniques in the biosciences, in numerical optimisation, in music and art domains, in image analysis and signal processing, in hardware optimisation and in a wide range of applications to scientific, industrial, financial and other real-world problems.

EVO* Poster

You can download the EVO* poster advertisement in PDF format here (Image: Pelegrina Galathea, by Stayko Chalakov (2009))

EVO* Call for Papers

You can download the EVO* CfP in PDF format here.

EuroGP

13th European Conference on Genetic Programming

EvoCOP

10th European Conference on Evolutionary Computation in Combinatorial Optimisation

EvoBIO

8th European Conference on Evolutionary Computation, Machine Learning and Data Mining in Bioinformatics

EvoApplications 2010

European Conference on the Applications of Evolutionary Computation

- EvoCOMNET: 7th European Event on the Application of Nature-inspired Techniques for Telecommunication Networks and other Parallel and Distributed Systems
- EvoCOMPLEX (new): Evolutionary Algorithms and Complex Systems
- EvoENVIRONMENT: Nature Inspired Methods for Environmental Issues
- EvoFIN: 4th European Event on Evolutionary and Natural Computation in Finance and Economics
- EvoGAMES: 2nd European event on Bio-inspired Algorithms in Games
- EvoIASP: EC in Image Analysis and Signal Processing
- EvoINTELLIGENCE: Nature Inspired Methods for Intelligent Systems
- EvoMUSART: 8th European event on Evolutionary and Biologically Inspired Music, Sound, Art and Design
- EvoNUM: 3rd European event on Bio-inspired algorithms for continuous parameter optimisation
- EvoSTOC: 7th European event on Evolutionary Algorithms in Stochastic and Dynamic Environments
- EvoTRANSLOG: 4th European Event on Evolutionary Computation in Transportation and Logistics

EvoPHD

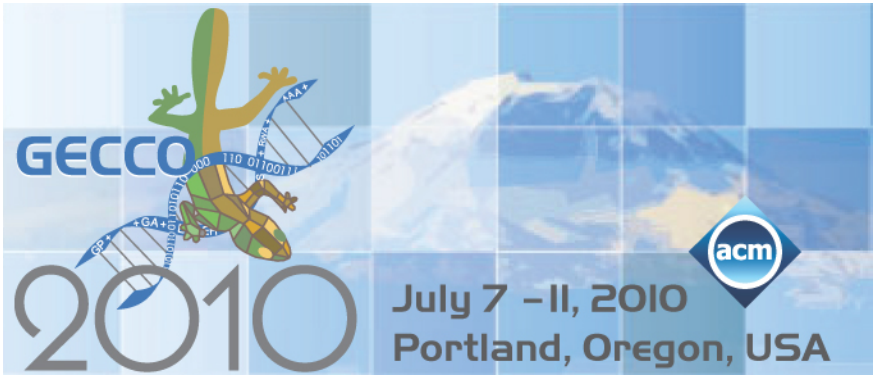
5th European Graduate Student Workshop on Evolutionary Computation

Evo* Coordinator: Jennifer Willies, Napier University, United Kingdom
j.willies@napier.ac.uk

Local Chair: Şima Uyar, Istanbul Technical University, Turkey
etaner@itu.edu.tr

Publicity Chair: Stephen Dignum, University of Essex, United Kingdom
sandig@essex.ac.uk

July 2010



GECCO 2010 - Genetic and Evolutionary Computation Conference
July 7-10, 2010, Portland, Oregon, USA
Homepage: http://www.sigevo.org/gecco-2010
Deadline January 27, 2010
Author notification: March 10, 2010
Camera-ready: April 5, 2010

The Genetic and Evolutionary Computation Conference (GECCO-2010) will present the latest high-quality results in the growing field of genetic and evolutionary computation.

Topics include: genetic algorithms, genetic programming, evolution strategies, evolutionary programming, real-world applications, learning classifier systems and other genetics-based machine learning, evolvable hardware, artificial life, adaptive behavior, ant colony optimization, swarm intelligence, biological applications, evolutionary robotics, coevolution, artificial immune systems, and more.

Organizers

General Chair:	Martin Pelikan
Editor-in-Chief:	Jürgen Branke
Local Chair:	Kumara Sastry
Publicity Chair:	Pier Luca Lanzi
Tutorials Chair:	Una-May O'Reilly
Workshops Chair:	Jaume Bacardit
Competitions Chairs:	Christian Gagné
Late Breaking Papers Chair:	Daniel Tauritz
Graduate Student Workshop	Riccardo Poli
Business Committee:	Erik Goodman
	Una-May O'Reilly
EC in Practice Chairs:	Jörn Mehnen
	Thomas Bartz-Beielstein,
	David Davis

Important Dates

Paper Submission Deadline	January 27, 2010
Decision Notification	March 10, 2010
Camera-ready Submission	April 5, 2010

Venue

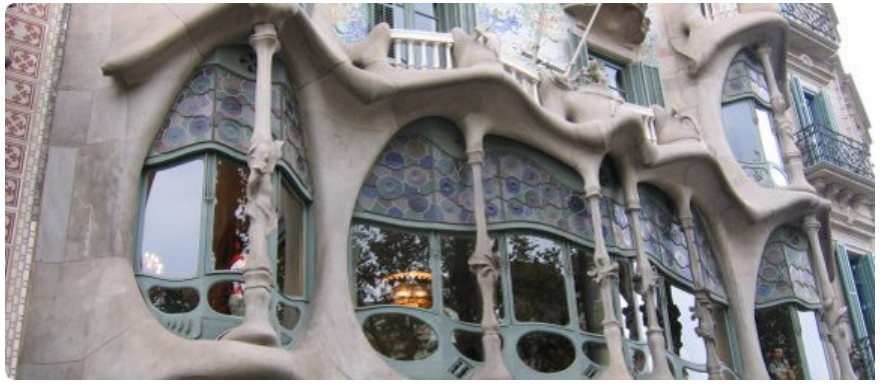
The Portland Marriott Downtown Waterfront Hotel, located in downtown Portland, is near the Portland Riverplace Marina, restaurants, shopping & performing arts venues. Hotel room conference rate $179 includes complimentary in-room high-speed Internet access.

More Information

Visit www.sigevo.org/gecco-2010 for information about electronic submission procedures, formatting details, student travel grants, the latest list of tutorials and workshop, late-breaking papers, and more.

For technical matters, contact Conference Chair Martin Pelikan at pelikan@cs.umsl.edu.
For conference administration matters contact Primary Support Staff at gecco-admin@tigerscience.com.

GECCO is sponsored by the Association for Computing Machinery Special Interest Group for Genetic and Evolutionary Computation.



2010 IEEE World Congress on Computational Intelligence

July 18-23, 2010, Barcelona, Spain

Homepage: WWW

Deadline January 31, 2010

The 2010 IEEE World Congress on Computational Intelligence (IEEE WCCI 2010) is the largest technical event in the field of computational intelligence. It will host three conferences: the 2010 International Joint Conference on Neural Networks (IJCNN 2010), the 2010 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE 2010), and the 2010 IEEE Congress on Evolutionary Computation (IEEE CEC 2010). IEEE WCCI 2010 will be held in Barcelona, a Mediterranean city located in a privileged position on the northeastern coast of Spain. Barcelona combines history, art, architecture, and charm within a pleasant, and efficient urban environment where meet old friends, and make new ones. The congress will provide a stimulating forum for scientists, engineers, educators, and students from all over the world to discuss and present their research findings on computational intelligence.

Important Due Dates

- Submission deadline: January 31, 2010
- Notification of paper acceptance: March 15, 2010
- Camera ready submission: May 2, 2010
- IEEE WCCI 2010 Conference: July 18-23, 2010

For more information visit http://www.wcci2010.org/call-for-papers

August 2010

IEEE Conference on Computational Intelligence and Games (CIG-2010)

August 18-21, 2010, Copenhagen, Denmark

Homepage: http://game.itu.dk/cig2010

Submission deadline: March 15, 2010

Decision notification: May 15, 2010

Camera-ready submission: June 15, 2010

Conference: August 18-21, 2010

Aim and Scope

Games have proven to be an ideal domain for the study of computational intelligence as not only are they fun to play and interesting to observe, but they provide competitive and dynamic environments that model many real-world problems. Additionally, methods from computational intelligence promise to have a big impact on game technology and development, assisting designers and developers and enabling new types of computer games. The 2010 IEEE Conference on Computational Intelligence and Games brings together leading researchers and practitioners from academia and industry to discuss recent advances and explore future directions in this quickly moving field.

Topics of interest include, but are not limited to:

- Learning in games
- Coevolution in games
- Neural-based approaches for games
- Fuzzy-based approaches for games
- Player/Opponent modeling in games
- CI/AI-based game design
- Multi-agent and multi-strategy learning
- Applications of game theory
- CI for Player Affective Modeling
- Intelligent Interactive Narrative
- Imperfect information and non-deterministic games
- Player satisfaction and experience in games
- Theoretical or empirical analysis of CI techniques for games
- Comparative studies and game-based benchmarking
- Computational and artificial intelligence in:
  - Video games
  - Board and card games
  - Economic or mathematical games
  - Serious games
  - Augmented and mixed-reality games
  - Games for mobile platforms

The conference will consist of a single track of oral presentations, tutorial and workshop/special sessions, and live competitions. The proceedings will be placed in IEEE Xplore, and made freely available on the conference website after the conference.

Conference Committee

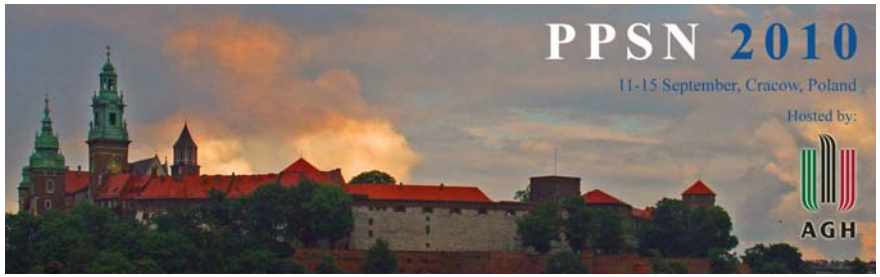
General Chairs:	Georgios N. Yannakakis and Julian Togelius
Program Chair:	Michael Mateas, Risto Miikkulainen, and Michael Young
Proceedings Chair:	Pier Luca Lanzi
Competition Chair:	Simon Lucas
Local Chairs:	Anders Drachen, Paolo Burelli, & Tobias Mahlmann

Important Dates

Tutorial proposals:	31st January 2010
Paper submission:	15th March 2010
Decision Notification:	15th May 2010
Camera-ready:	15th Jun 2010
Conference:	18-21 August 2010

For more information please visit: http://game.itu.dk/cig2010/

September 2010



PPSN 2010 – International Conference on Parallel Problem Solving From Nature
September 11-15, 2010, Cracow, Poland
Homepage: http://home.agh.edu.pl/ppsn
Deadline: April 6, 2010

The Eleventh International Conference on Parallel Problem Solving from Nature (PPSN XI) will be held at the AGH University of Science and Technology in Cracow, Poland on 11-15 September 2010. This biennial meeting aims to bring together researchers and practitioners in the field of natural computing. Natural Computing is the study of computational systems, which use ideas and get inspiration from natural systems, including biological, ecological, physical, chemical, and social systems. It is a fast-growing interdisciplinary field, in which a range of techniques and methods are studied for dealing with large, complex, and dynamic problems with various sources of potential uncertainties.

PPSN XI will be a showcase of a wide range of topics in Natural Computing including, but not restricted to: Evolutionary Computation, Neural Computation, Molecular Computation, Quantum Computation, Artificial Life, Swarm Intelligence, Artificial Ant Systems, Artificial Immune Systems, Self-Organizing Systems, Emergent Behaviors, and Applications to Real-World Problems. PPSN XI will also feature workshops and tutorials covering advanced and fundamental topics in the field of natural computation.

All accepted papers will be presented during poster sessions and will be included in the proceedings. Following the tradition of PPSN, proceedings will be published in the Series Lecture Notes in Computer Science (LNCS) by Springer.

Paper Presentation Following the now well-established tradition of PPSN conferences, all accepted papers will be presented during small poster sessions of about 16 papers. Each session will contain papers from a wide variety of topics, and will begin by a plenary quick overview of all papers in that session by a major researcher in the field. Past experiences have shown that such presentation format led to more interactions between participants and to a deeper understanding of the papers. All accepted papers will be published in the Proceedings.

General Chair

Robert Schaefer (AGH, Cracow, PL)

Honorary Chair

Hans-Paul Schwefel (Tech. Universität Dortmund, DE)

Program Co-Chairs

Carlos Cotta (University of Malaga, ES)
Joanna Kolodziej (University of Bielsko-Biala, PL)
Günter Rudolph (Tech. Universität Dortmund, DE)

Tutorials Chair

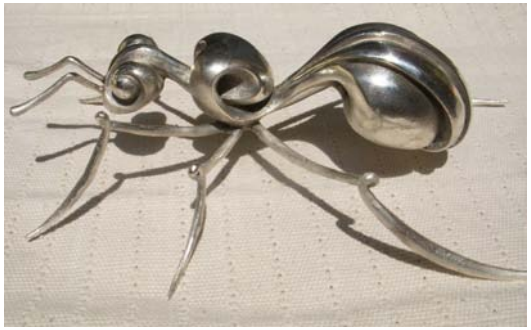
Krzysztof Cetnarowicz (AGH, Cracow, PL)

Workshop Chair

Aleksander Byrski (AGH, Cracow, PL)

Important dates

Workshop Proposals Submission	January 3, 2010
Workshop Proposals Notification	February 19, 2010
Paper Submission	April 6, 2010
Author Notification	May 21, 2010
Papers Camera Ready Submission	June 11, 2010
Early Registration	June 11, 2010
Conference	September, 11-15, 2010



Seventh International Conference on Swarm Intelligence

September 8-10, 2010. Brussels, Belgium

Homepage: http://iridia.ulb.ac.be/ants2010

Deadline February 28, 2010

Swarm intelligence is a relatively new discipline that deals with the study of self-organizing processes both in nature and in artificial systems. Researchers in ethology and animal behavior have proposed many models to explain interesting aspects of social insect behavior such as self-organization and shape-formation. Recently, algorithms and methods inspired by these models have been proposed to solve difficult problems in many domains.

An example of a particularly successful research direction in swarm intelligence is ant colony optimization, the main focus of which is on discrete optimization problems. Ant colony optimization has been applied successfully to a large number of difficult discrete optimization problems including the traveling salesman problem, the quadratic assignment problem, scheduling, vehicle routing, etc., as well as to routing in telecommunication networks.

Another interesting approach is that of particle swarm optimization, that focuses on continuous optimization problems. Here too, a number of successful applications can be found in the recent literature. Swarm robotics is another relevant field. Here, the focus is on applying swarm intelligence techniques to the control of large groups of cooperating autonomous robots.

ANTS 2010 will give researchers in swarm intelligence the opportunity to meet, to present their latest research, and to discuss current developments and applications.

The three-day conference will be held in Brussels, Belgium, on September 8-10, 2010. Tutorial sessions will be held in the mornings before the conference program.

Relevant Research Areas

ANTS 2010 solicits contributions dealing with any aspect of swarm intelligence. Typical, but not exclusive, topics of interest are:

- Behavioral models of social insects or other animal societies that can stimulate new algorithmic approaches.
- Empirical and theoretical research in swarm intelligence.
- Application of swarm intelligence methods, such as ant colony optimization or particle swarm optimization, to real-world problems.
- Theoretical and experimental research in swarm robotics systems.

Publication Details As for previous editions of the ANTS conference, proceedings will be published by Springer in the LNCS series (to be confirmed). The journal Swarm Intelligence will publish a special issue dedicated to ANTS 2010 that will contain extended versions of the best research works presented at the conference.

Best Paper Award

A best paper award will be presented at the conference.

Further Information

Up-to-date information will be published on the web site http://iridia.ulb.ac.be/ants2010/. For information about local arrangements, registration forms, etc., please refer to the above-mentioned web site or contact the local organizers at the address below.

Conference Address

ANTS 2010	
IRIDIA CP 194/6	Tel +32-2-6502729
Université Libre de Bruxelles	Fax +32-2-6502715
Av. F. D. Roosevelt 50	http://iridia.ulb.ac.be/ants2010
1050 Bruxelles, Belgium	email: ants@iridia.ulb.ac.be

Important Dates

Submission deadline	March 28, 2010
Notification of acceptance	April 30, 2010
Camera ready copy	May 14, 2010
Conference	September 8–10, 2010

About the Newsletter

SIGEVOlution is the newsletter of SIGEVO, the ACM Special Interest Group on Genetic and Evolutionary Computation.

To join SIGEVO, please follow this link [WWW]

Contributing to SIGEVOlution

We solicit contributions in the following categories:

Art: Are you working with Evolutionary Art? We are always looking for nice evolutionary art for the cover page of the newsletter.

Short surveys and position papers: We invite short surveys and position papers in EC and EC related areas. We are also interested in applications of EC technologies that have solved interesting and important problems.

Software: Are you are a developer of an EC software and you wish to tell us about it? Then, send us a short summary or a short tutorial of your software.

Lost Gems: Did you read an interesting EC paper that, in your opinion, did not receive enough attention or should be rediscovered? Then send us a page about it.

Dissertations: We invite short summaries, around a page, of theses in EC-related areas that have been recently discussed and are available online.

Meetings Reports: Did you participate to an interesting EC-related event? Would you be willing to tell us about it? Then, send us a short summary, around half a page, about the event.

Forthcoming Events: If you have an EC event you wish to announce, this is the place.

News and Announcements: Is there anything you wish to announce? This is the place.

Letters: If you want to ask or to say something to SIGEVO members, please write us a letter!

Suggestions: If you have a suggestion about how to improve the newsletter, please send us an email.

Contributions will be reviewed by members of the newsletter board.

We accept contributions in LaTeX, MS Word, and plain text.

Enquiries about submissions and contributions can be emailed to editor@sigevolution.org.

All the issues of SIGEVOlution are also available online at www.sigevolution.org.

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GPUs for Genetic and Evolutionary Computation

2010 Genetic and Evolutionary Computation Conference
Wednesday – Sunday July 7 –11, 2010 Portland, Oregon, USA

We are pleased to announce the official start of the GPU competition of GECCO-2010 with the publication of the competition rules and the scoring system.

The Goal

This competition focuses on the applications of genetic and evolutionary computation that can maximally exploit the parallelism provided by low-cost consumer graphical cards. The competition will award the best applications both in terms of degree of parallelism obtained, in terms of overall speed-up, and in terms of programming style.

Rules and Regulations

Entrants must submit (1) the application sources with the instructions to compile it and (2) a two page description of the application. Submissions will be reviewed by a committee of researchers from the evolutionary computation community and from industry. Each reviewer will score the submission according to 12 criteria concerning the submitted algorithm, the speed-up it achieves, and its impact on the evolutionary computation community. The total score will be obtained as the weighted sum of the 12 separate scores.

Submissions should be mailed to gecco2010@gpgpgpu.com no later than June 23, 2009. The final scores will be announced during GECCO.

Important Dates

Submission deadline: June 4th 2010
Conference: July 7th-11th 2010

Organizers

Simon Harding, Memorial University of Newfoundland, Canada
David Luebke, NVIDIA
Pier Luca Lanzi, Politecnico di Milano
Edmondo Orlotti, NVIDIA

Sponsor of the GECCO-2010 competitions.

Scoring

Submissions will be reviewed by a panel of researchers from the evolutionary computation community and from industry who will score each submission according to the following criteria.

Algorithm (50% of the total score)

Novelty	10%	Does the algorithm exploit the GPU in a novel way? (e.g., not just for fitness evaluation?)
Efficiency	10%	Does the algorithm efficiently use the GPU?
GPU-side	10%	How much of the algorithm is implemented GPU side?
Elegance	5%	Is the algorithm simple, easy to understand?
Portability	5%	Is the code parameterized for different GPU architectures and/or across vendors?
Suitability	10%	Does it use features of the GPU architecture logically and to the advantage of the program?

Speed (20% of the total score)

Speedup	10%	How much is the speed up compared to a well coded CPU version?
Resources	5%	What is the resource utilization? (Ideally a program should use the 100% of the GPU).
Scalability	5%	Will it scale? E.g. to new hardware, multiple GPUs, GPUs with fewer/more processors?

Evolutionary Computation (30% of the total score)

Utility	10%	Do the results benefit the EC/GA/GP community?
Practicality	10%	Were the results practically obtainable without GPU acceleration?
Science	10%	Is the system used to generate better quality science? For example, increasing statistical significance, increasing coverage of test cases or demonstrating greater generalization.