Poster Session 1

11h – 12:30h

A gentle introduction
by
Prof. Enrique Alba

Articles in section #1

- **Online Black-box Algorithm Portfolios for Continuous Optimization** – *Petr Baudis, Petr Posk*
- **Self-adaptive Genotype-Phenotype Maps: NNs as a Meta-representation** – *L.F. Simoes, D. Izzo, E. Haasdijk, A.E. Eiben*
- **Derivation of a Micro-Macro Link for Collective Decision-Making Syst.** – H. Hamann, G.Valentini, Y. Khaluf, M. Dorigo
- **Natural Gradient Approach for Linearly Constrained Continuous Optimization** – *Y. Akimoto, S. Shirakawa*
- **A Study on Multimemetic Estimation of Distribution Algorithms** – *R. Nogueras, C. Cotta*
- **Compressing Regular Expression Sets for Deep Packet Inspection** – *A. Bartoli, S. Cumar, A. De Lorenzo, E. Medvet*
- **On the Locality of Standard Search Operators in Grammatical Evolution** – *A. Thorhauer, Franz Rothlauf*
- **Clustering-Based Selection for Evolutionary Many-Objective Optimization** – R. Denysiuk, L. Costa, I. Espírito Santo
- **Discovery of Implicit Objectives by Compression of Interaction Matrix in Test-based Problems** – Liskowski, Krawiec
- **Using a Family of Curves to Approximate the Pareto Front of a Multi-Objective Optimization Problem** – S. Zapotecas Martínez1, V. A. Sosa Hernández, H. Aguirre, K. Tanaka and C. A. Coello Coello
- **Combining Evolutionary Computation and Algebraic Constructions to find Cryptography-relevant Boolean Functions** – S. Picek1, E. Marchiori, L. Batina, D. Jakobovic
- **Coupling Evolution and Inf. Theory for Autonomous Robotic Exploration** – G. Zhang, M. Sebag
- **Unbiased Black-Box Complexity of Parallel Search** – G. Badkobeh, P. K. Lehre, D. Sudholt

Online Black-box Algorithm Portfolios for Continuous Optimization

Petr Baudis and Petr Posk

Some keywords
Black box
Algorithm Portfolios
Hyperheuristics
Learn on the fly

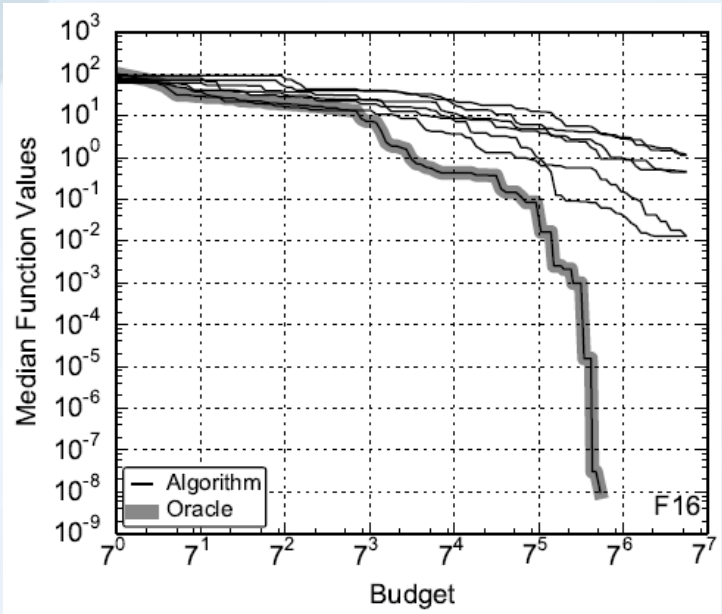
The main goal
Given a particular function to be optimized:
how to select the appropriate Algorithm?

The proposal
Several original selection strategies based on the UCB1 multi-armed bandit policy (7 algorithms)

The problem solved
BBOB workshop reference functions

The conclusion
Algorithm portfolios are beneficial in practice, even with some fairly simple strategies

What's interesting?
Their classifications by solver, winner and convergence



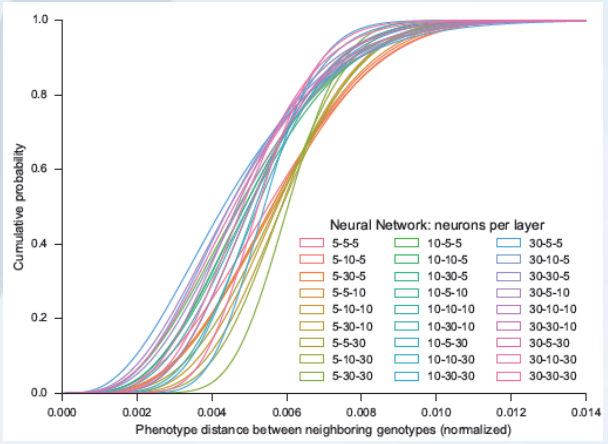
Self-adaptive Genotype-Phenotype Maps: NNs as a Meta-representation

Luís F. Simoes, Dario Izzo, Evert Haasdijk, and A. E. Eiben

Some keywords
From Gen-to-Phen
Neuroevolution
Selfadapt representations

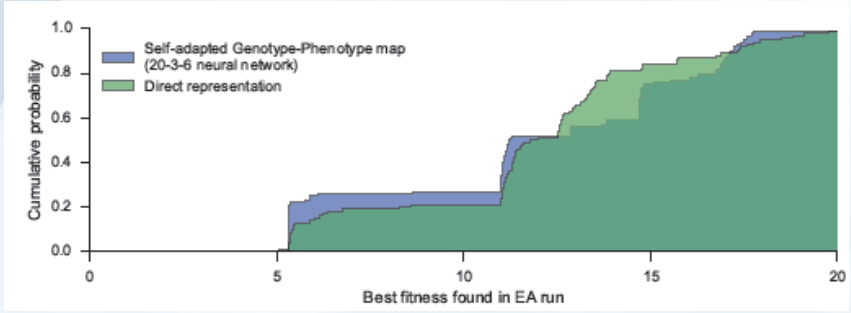
The main goal
Step forward in automated EA design by tuneable ANN maps in continuous problems

The proposal
A NN is used to go from G-P



The problem solved
Automatic G-P mapping, learnability and expressiveness
Cassini 1 and Messenger_full (space trajectory design!)

The conclusion
Small-medium NNs can preserve locality in G-P while redundancy is tuneable (#input neurons)



What's interesting?
Nice proof-of-concept!
They create genotype-phenotype maps being self-adapted, concurrently, with the evolution of solutions...
Make your computer to design your EA!!!

Derivation of a Micro-Macro Link for Collective Decision-Making Systems

Heiko Hamann, Gabriele Valentini, Yara Khaluf, and Marco Dorigo

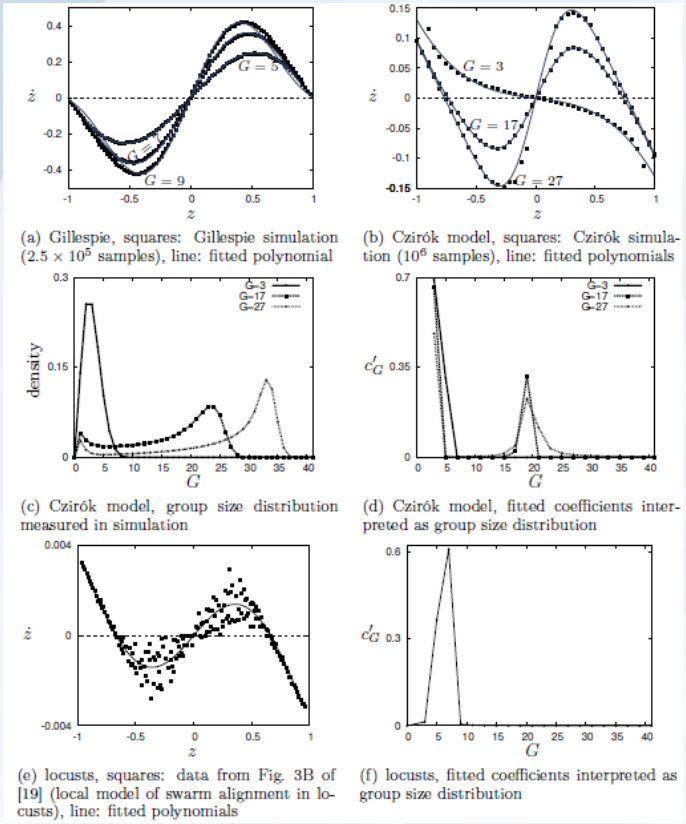
Some keywords
Mathematical models
Selforganizing agents
Polynomial fitting

The main goal
Relating microscopic features (individual level) to macroscopic features (swarm level) of self-organizing collective systems

$$\langle \dot{z} \rangle = -\varepsilon z + \sum_{G \in \mathcal{G}} c_G p_G(z)$$

The proposal
From a master equation authors derive the drift term of a stochastic differential equation (macro-model) to predict the swarm behavior

The problem solved
Gillespie and Locust assignment simulations



(a) Gillespie, squares: Gillespie simulation (2.5×10^5 samples), line: fitted polynomial

(b) Czirók model, squares: Czirók simulation (10^6 samples), line: fitted polynomials

(c) Czirók model, group size distribution measured in simulation

(d) Czirók model, fitted coefficients interpreted as group size distribution

(e) locusts, squares: data from Fig. 3B of [19] (local model of swarm alignment in locusts), line: fitted polynomials

(f) locusts, fitted coefficients interpreted as group size distribution

The conclusion
Local subgroups can temporarily take global decisions

What's interesting?
The micro-macro link concept
and
how chemical reactions help us!

Natural Gradient Approach for Linearly Constrained Continuous Opt.

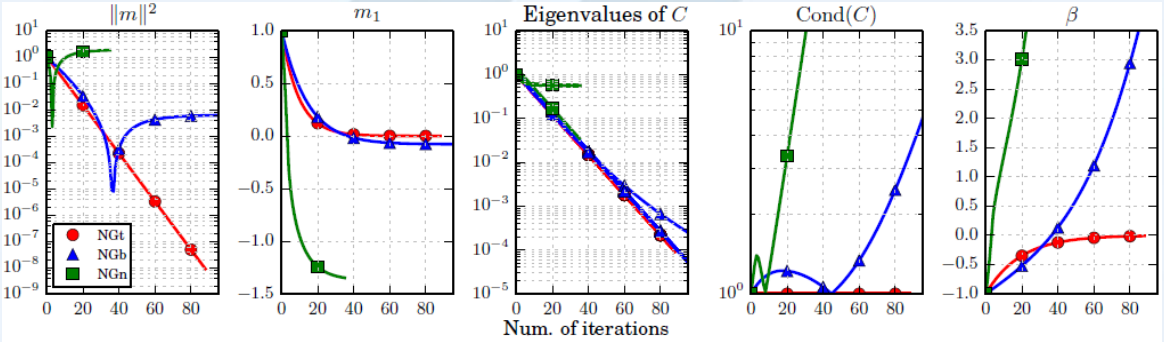
Youhei Akimoto and Shinichi Shirakawa

Some keywords
Continuous optimization
Boundaries constrained Pr.

The main goal
To construct the parameter update rule for the covariance matrix adaptation evolution strategy from the same principle as unconstr.

The problem solved
Minimization of a spherical function with a linear constraint

The proposal
Use resampling to allow CMAES to go for constrained problems: rank-μ update CMA



What's interesting?
The kind of analysis including expected and actual natural gradients

The conclusion
There are similarities to natural gradient approaches plus a tricky balance depending on weights

A Study on Multimemetic Estimation of Distribution Algorithms

Rafael Nogueras and Carlos Cotta

Some keywords
Multimemetic Algorithms
Self-adaptation
Elitism
EDAs

The main goal
Advance in MMAs and get rid of variation operators plus the analysis of meme diversity and success

The proposal
Use EDAs to evolve the memes (solving strategies) encoded along genotypes in MMAs

The problem solved
Deb's trap function, HIFF, HXOR, SAT

The conclusion
Elitist versions of MM EDAs using bivariate models outperform genetic MMAs

What's interesting?
Less parameters and future advanced models for solutions and memes

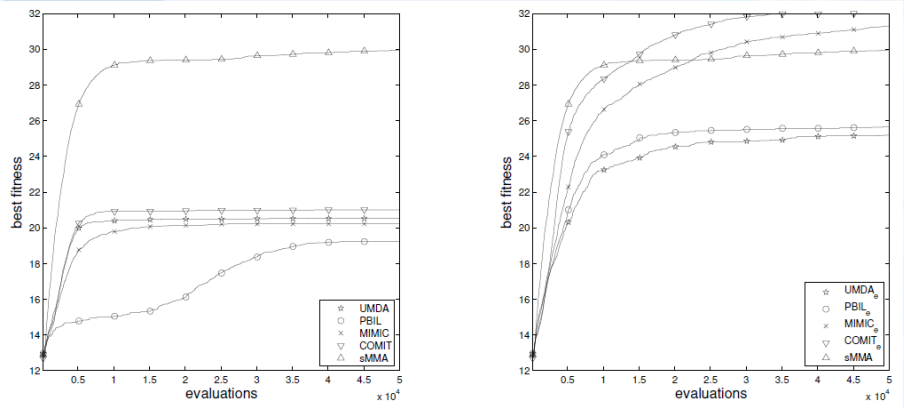


Fig. 1. Evolution of best fitness in TRAP for non-elitist multimemetic EDAs (left) and elitist ones (right). The results of sMMA are included in both figures.

Compressing Regular Expression Sets for Deep Packet Inspection

Alberto Bartoli, Simone Cumar, Andrea De Lorenzo, and Eric Medvet

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Some keywords
Genetic programming
Intrusion detection
Network traffic classification

The main goal
To generate security-related alerts while analyzing network traffic in real time

The proposal
Reduce the set of regular expressions used to detect attack signatures (efficiency)

The problem solved
The Snort intrusion detection system (7 datasets)

R_s	Without completion steps				With completion steps			
	FPR	FNR	Acc.	$1-\frac{c(R_f)}{c(R_s)}$	FPR	FNR	Acc.	$1-\frac{c(R_f)}{c(R_s)}$
chat.rules.pcre	0.0	50.0	75.0	96.10	0.0	0.0	100.0	70.66
pop3.rules.pcre	2.7	0.0	98.7	91.33	2.7	0.0	98.7	91.33
policy.rules.pcre	88.5	0.0	55.9	8.62	88.5	0.0	55.9	8.62
web-php.rules.pcre	24.5	6.3	84.6	67.00	24.5	0.0	87.8	66.50
ftp.rules.pcre	15.9	7.4	88.4	53.96	15.9	0.0	92.2	48.99
spyware-put.rules.pcre	3.3	9.5	93.6	99.01	1.6	0.0	98.3	91.26
web-activex.rules.pcre	0.0	0.0	100.0	99.97	0.0	0.0	100.0	99.97

The conclusion
GP helps reducing up to 74% the size of the rules (trees) used to detect attacks

What's interesting?
Compression can arrive to 90% (!)
How GP can help to approach RT

On the Locality of Standard Search Operators in Grammatical Evolution

Ann Thorhauer and Franz Rothlauf

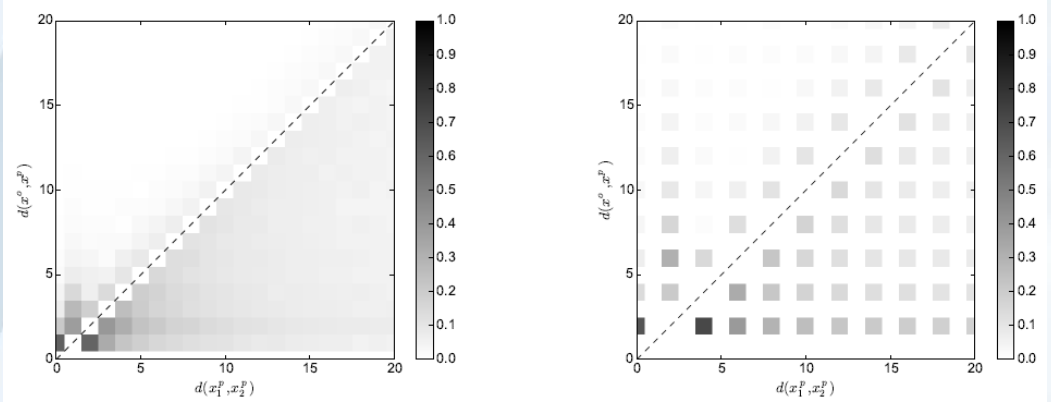
Some keywords
Inheritance and distance
Reduction of locality
Geometric crossover
Random walk

The main goal
To examine the locality of standard operators in Grammatical evolution (GE) and GP

The proposal
A nice analysis of locality

The problem solved
Binary tree problems

The conclusion
Standard ops. have low locality (bad!) and GE has a larger locality than GP



(a) GE (b) GP

Fig. 1. Distribution of $d(x^o, x_j^p)$ $(j \in \{1, 2\})$ over $d(x_1^p, x_2^p)$.

What's interesting?
We now know more on operators and GE, and GP... Use this!

Clustering-Based Selection for Evolutionary Many-Objective Optimization

Roman Denysiuk, Lino Costa, and Isabel Espírito Santo

Some keywords
Manyobjective
Clustering
Hypervolume

The main goal
Improve the scalability when having many objectives

The proposal
Transform the objective vectors by applying a clustering and select cluster representatives according to the distance to a reference point

The problem solved
DTLZ (1-2-3-4-7), 30 variables, 2..20 objectives

Indicator	EMyO/C	IBEA	MOEA/D	MSOPS	MSOPS2	HypE
$\epsilon+$	$1.73^{4,5,6}$	$2.63^{5,6}$	$3.10^{5,6}$	3.50^{5}	5.27	4.87
HV	$2.08^{3,4,5,6}$	$2.10^{3,4,5,6}$	3.63	3.82	4.67	4.70
IGD	$1.73^{4,5,6}$	$2.97^{5,6}$	$2.90^{5,6}$	3.97	4.77	4.67

Table 2. Mean ranks achieved by different algorithms. The superscripts 1, 2, 3, 4, 5, and 6 indicate whether the respective algorithm performs significantly better than EMyO/C, IBEA, MOEA/D, MSOPS, MSOPS2, and HypE, respectively.

What's interesting?
EMyOC beats IBEA, MOEA/D, MSOPS, MSOPS2, and HypE
Could be selfadjusted

The conclusion
Improving the diversity by using clustering beats state of the art manyobjective techniques

Discovery of Implicit Objectives by Compression of Interaction Matrix in Test-based Problems

Paweł Liskowski and Krzysztof Krawiec

Some keywords
Multiobjective
Complex fitness
Test efficiency

The main goal
Discover underlying skills in game strategies by compressing the interaction outcomes (objectives)

The proposal
A heuristic method compressing the original interaction outcomes into a few derived objectives ('lossy' manner)

The problem solved
Multi-choice Iterated Prisoner's Dilemma

The conclusion
This approach beats the more usual coevolution technique (CEL)

What's interesting?
NSGA-II application to manyobjective
The mixture of MO and clustering
No aggregation into scalar values done

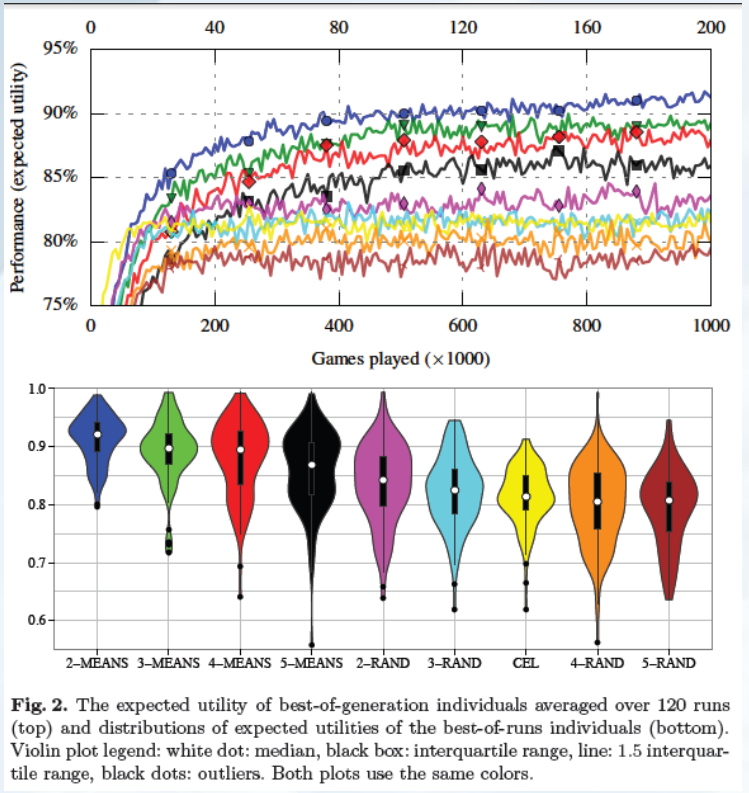


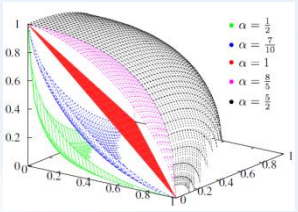
Fig. 2. The expected utility of best-of-generation individuals averaged over 120 runs (top) and distributions of expected utilities of the best-of-runs individuals (bottom). Violin plot legend: white dot: median, black box: interquartile range, line: 1.5 interquartile range, black dots: outliers. Both plots use the same colors.

Using a Family of Curves to Approximate the Pareto Front of a Multi-Objective Optimization Problem

S. Zapotecas Martínez1, V. A. Sosa Hernández, H. Aguirre, K. Tanaka and C. A. Coello Coello

Some keywords
Hypervolume
Manyobjective
Efficiency

The main goal
Find a substitute for hypervolume for selection in algorithms solving manyobjective problems

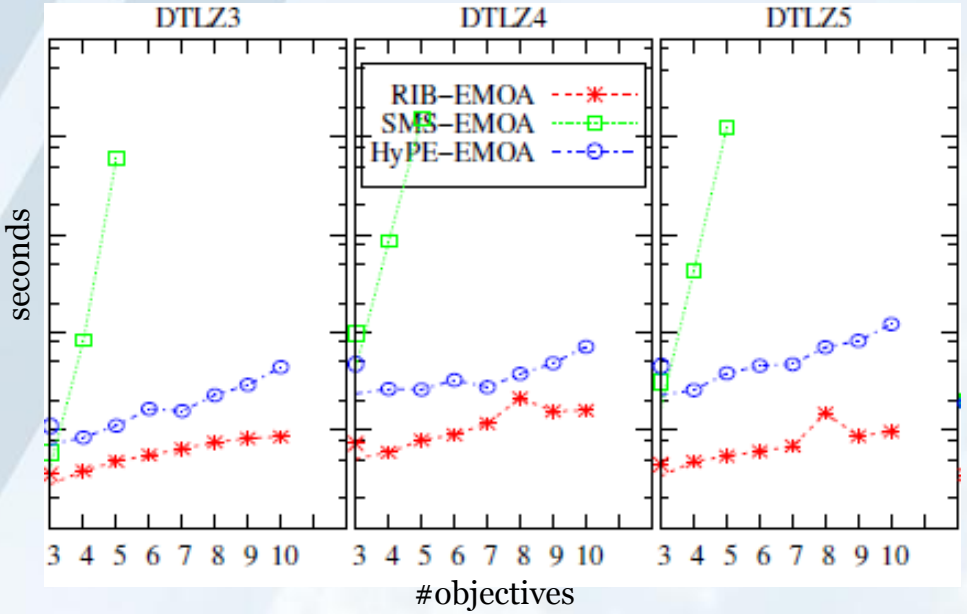


The proposal
A Reference Indicator-Based Evolutionary Multi-Objective Alg. (RIB-EMOA), based on Δ_p to build a reference set by using a family of curves

The problem solved
DTLZ 1..7 of up to 10 objectives

The conclusion
The new technique beats state of the art algorithms in running time

What's interesting?
The geometric conception of the Pareto front and the future research in how to create the reference sets



Combining Evolutionary Computation and Algebraic Constructions to find Cryptography-relevant Boolean Functions

Stjepan Picek1, Elena Marchiori, Lejla Batina and Domagoj Jakobovic

Some keywords
Boolean Functions
Nonlinearity
Bent Functions
Cryptographic Properties

The main goal
Find Boolean functions with specific properties

The proposal
Tow phases, considering (1) EC, algebraic methods, and (2) hybrids

The problem solved
Find a balanced Boolean function with an 8-bit input and nonlinearity 118

The conclusion
Better results than SOTA, approaching 118

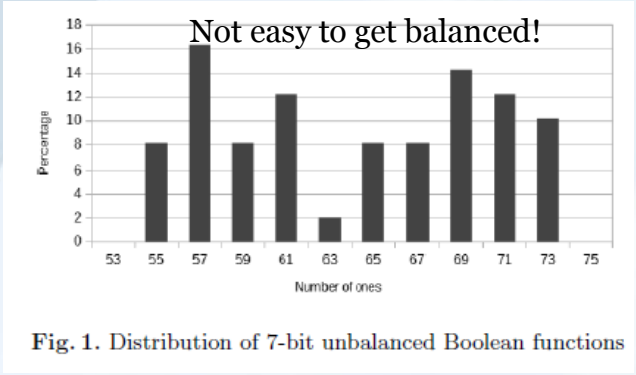


Fig. 1. Distribution of 7-bit unbalanced Boolean functions

What's interesting?
The integration of algebraic and EC techniques...and the nice scientific looking of work

Table 2. Phase 2 - algorithm combinations

Experiment	NL_f	Min	Max	Mean	Stdev	SUCCESS(%)
I (GP+seed)	116	113	117	113.55	1.379	13.8
II (GP+seed+HC)	116	113	117	113.8	0.91	19.6
III (GP+seed+GA)	116	113	117	115.32	0.43	67.1

Coupling Evolution and Inf. Theory for Autonomous Robotic Exploration

Guohua Zhang and Michèle Sebag

The main goal
Improve the exploratory behavior in robotics

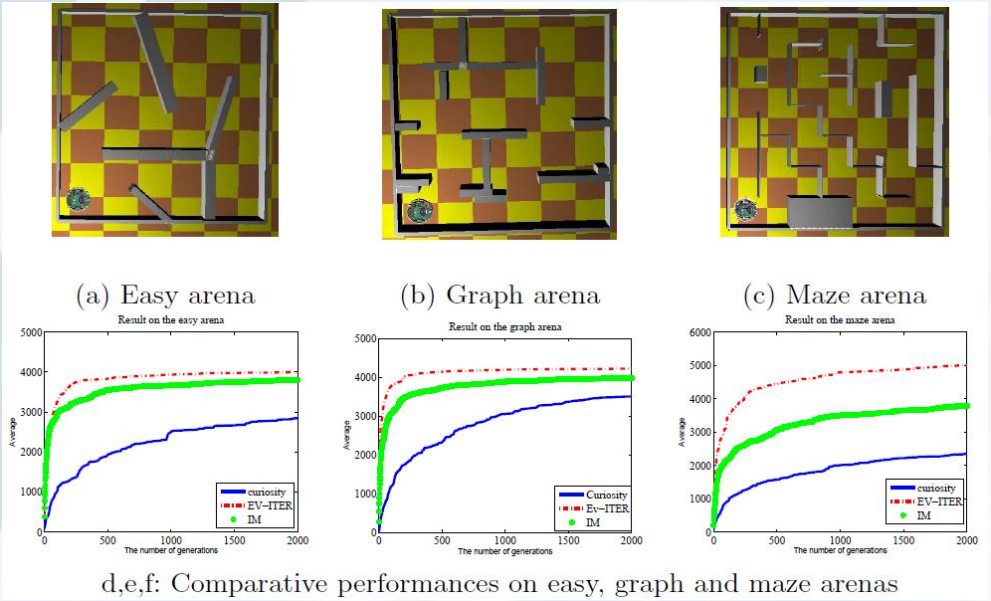
Some keywords
Robotics
EC
Learning
Theory of information

The proposal
(1) Maximize controllers to get more info from sensors
(2) This is is used to support decision making in every step

The problem solved
Movement in different mazes

The conclusion
A new algorithm beating its component algorithms

What's interesting?
The generalization abilities allowing good behavior in unseen scenarios



d,e,f: Comparative performances on easy, graph and maze arenas

EvITE is great!

Unbiased Black-Box Complexity of Parallel Search

Golnaz Badkobeh, Per Kristian Lehre, and Dirk Sudholt

Some keywords
Theory
Black box
Convergence

The main goal
Compute the complexity for algorithms evaluating several search points at a time

The proposal
Compute the lower bound for the number of steps that every algorithm needs to optimise a given problem

The problem solved
Onemax, Leading ones, single optimum functions

The conclusion
Lower bounds depending on the number of visited points at a time

Theorem 3. *For any $\lambda \leq e^{\sqrt{n}}$ the λ-parallel unbiased unary black-box complexity for any function with a unique optimum is at least*

$$\Omega\left(\frac{\lambda n}{\ln \lambda} + n \log n\right).$$

This bound is tight for OneMax*, where the cut-off point is*

$$\lambda^*_{\text{OneMax}} = \Theta(\log(n) \cdot \log\log n).$$

The corresponding parallel time for an optimal algorithm is $\Omega\left(\frac{n}{\ln \lambda} + \frac{n \log n}{\lambda}\right)$.

What's interesting?
The models apply to unary operators like mutation and local search, and lower bounds are really useful as baselines

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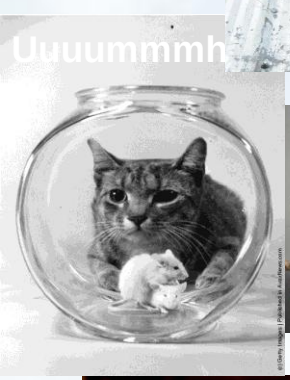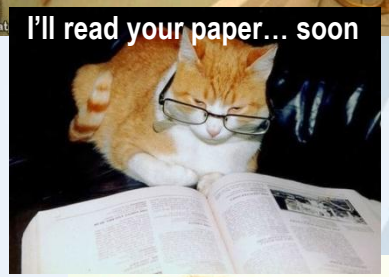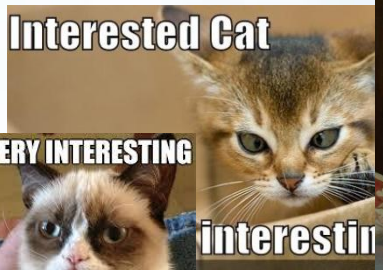
ENJOY !