

Evolutionary Computation Benchmarking Repository

Evolutionary Computation has been used with great success for the solution of hard optimization problems, e.g., multi-modal, noisy, NP-hard or dynamic optimization problems, to name a few. Theoretical analysis, although important in its own right, e.g. for understanding underlying phenomena and characteristics of evolutionary search, can only provide upper and/or lower bounds of performance estimation of evolutionary algorithms for hard optimization problems. In practice, empirical analysis is the most important means to assess and compare the performance of algorithms. In order to provide a fair and comprehensive assessment, it is necessary to make sure that a number of considera-

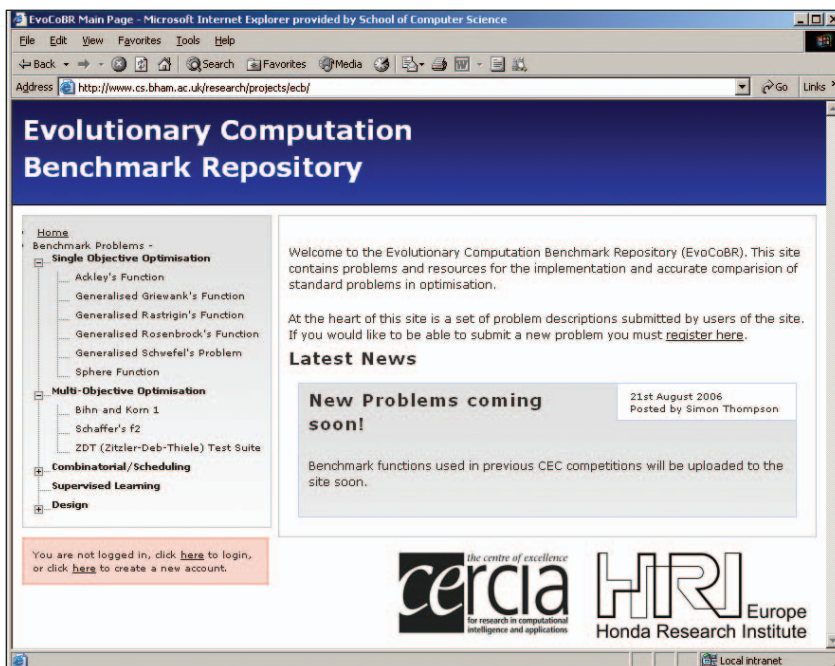
tions are taken into account. First, the choice of the empirical test function has to be well founded. It should represent either the characteristics of a certain practically relevant problem class or of a theoretical problem property, or be of considerable practical interest in itself. Second, the empirical analysis must be sound [1], i.e., the right statistical tools must be employed. Third, the analysis must be transparent and reproducible. If these considerations are observed, then we will be in a better position to decide which type of evolutionary algorithm, or parts of an algorithm, like representation, variation operators or selection method, is most suitable for a problem class or for a problem characteristic.

In order to facilitate this fair and transparent comparison, the Evolutionary Computation Benchmarking Repository (EvoCoBR) [2] has been designed and put into operation in a beta version and trial phase. The aim is to create a central Web-based repository for storing detailed benchmark problem descriptions. This has been successfully done in other related disciplines, such as the UCI machine-learning repository [3] and the Proben dataset [4] for neural networks. However, with EvoCoBR we want to go one step further and archive, along with the problem description, a list of references to previously achieved results and the best result so far. This enables researchers to more easily see how their results compare to results in the literature. EvoCoBR will also invite researchers to submit and archive the programs that produced those results. EvoCoBR's architecture enables the entire evolutionary computation community to contribute and own the Web-based archive. Its contents will be submitted by researchers and practitioners, and openly accessible by all. In other words, the EvoCoBR design defines the framework that needs to be filled by the evolutionary computation community for the evolutionary computation community.

Repository Structure

A Web-based repository—a database—was created in order to address the issues described above. The system has the following major components:

- A PostgreSQL database that stores the problem descriptions.



- A PHP front end that provides a Web-based user interface to the database.
- A third-party template engine that renders the pages based on a set of common page layouts.

In order to address the issues of problem representation, a format was created that is flexible enough to cope with many different styles of problems and even extend to accommodate new requirements. Users can enter their problem description in a flexible wiki style format¹, which allows sufficient control over the content and layout of the output. Images and LaTeX equations can be added to the description, and other file types such as PDF, PS, and CSV can also be uploaded and linked to the page. This enables even the most complex problems to be described in a simple and straightforward way.

The functionality of the site is written using PHP, but the layout of the Web pages is handled by the template engine Smarty².

EvoCoBR is designed to be largely maintained by the users rather than by a single central administrator. This approach requires careful thought about security requirements. While a flexible input format allows the creation of high quality problem descriptions, it also opens up the system to the possibility of abuse. In order to address this issue, a security system is implemented in which users have varying levels of privileges. Only when a user has registered with the site, is he or she allowed to submit new problem descriptions, which will not appear on the Web site until approved by a more privileged user. After some time, a user may become “trusted”, after which his/her submissions will no longer need approval and will instantly appear on the Web site.

The entire security structure of the repository can be seen in the following table.

Users can be promoted to the next level by anyone of a higher level. In our current implementation, registered users are automatically converted to trusted users when three of their submissions have been approved.

¹ See <http://en.wikipedia.org/wiki/Wiki>
² See <http://smarty.php.net/>

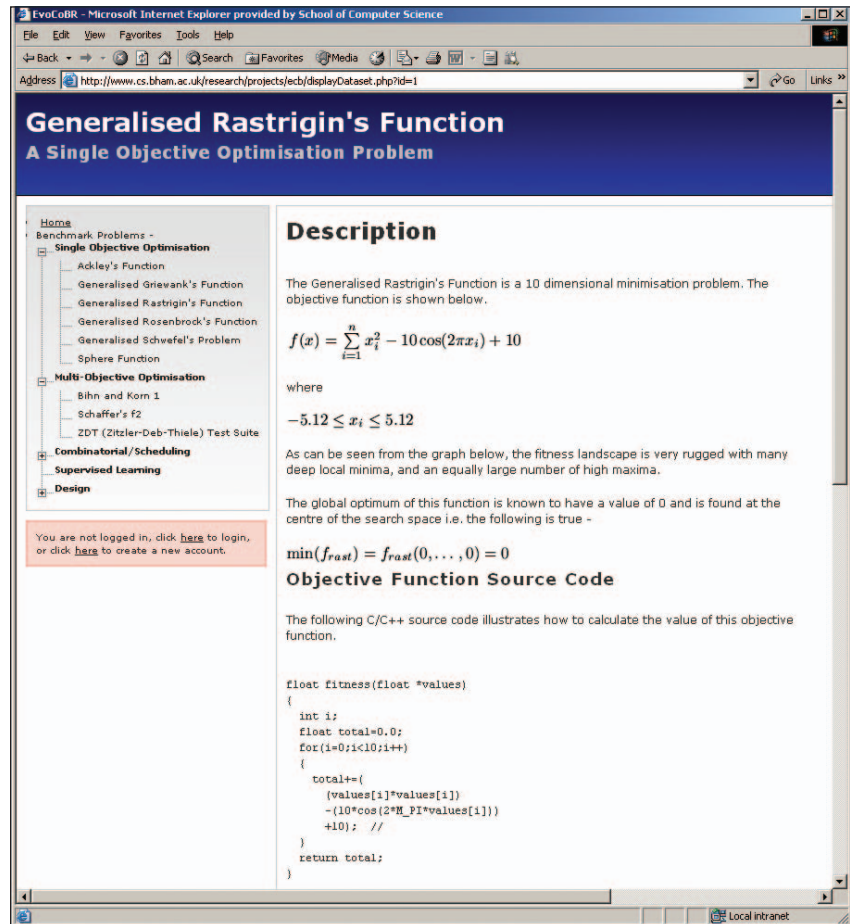


TABLE 1

Level	Add	Edit	Delete	Approve	Mail
Admin	INSTANT	ANY	ANY	YES	YES
Power	INSTANT	ANY	ANY	YES	YES
Trusted	INSTANT	ANY	OWN	NO	NO
Registered	SUBMIT ONLY	OWN	OWN	NO	NO

Summary and Future Work

A Web-based problem, performance and reference repository for evolutionary computation (extendable to computational intelligence in general) has been designed and developed:

Evolutionary Computation Benchmarking Repository—EvoCoBR

The repository is currently hosted by CERCIA at the University of Birmingham:

<http://www.cs.bham.ac.uk/research/projects/ecb/>.

It provides a flexible and extendable framework for evolutionary computa-

tion researchers to submit and share their test problems and best solutions. It provides a central archive of benchmark problems with different characteristics, which people can use to evaluate and compare their newly developed algorithms against the state-of-the-art. The current version is only an early beta version and runs as a test trial. Nevertheless, we believe that it is time that we open it to the entire research community so that further improvement can be made according to feedback we receive. Please send all

(continued on page 60)

- * Denotes a CIS-sponsored conference
- Δ Denotes a CIS-cosponsored or cooperation conference

Δ 1st International Workshop on Semantic Media Adaptation & Personalization

Athens, Greece
December 5, 2006
General Chair: Manolis Wallace
<http://image.ntua.gr/events/smap/submissions>

Δ BIONETICS

Trento, Italy
December 11–13, 2006
General Chair: Tatsuya Suda and Christian Tschudin
<http://www.bionetics.org/>

* 2007 IEEE Symposium Series on Computational Intelligence

A joint conference of

- IEEE Symposium on Computational Intelligence in Image and Signal Processing
- IEEE Symposium on Approximate Dynamic Programming and Reinforcement Learning
- IEEE Symposium on Computational Intelligence and Data Mining
- IEEE Symposium on Computational Intelligence in Bioinformatics and Computational Biology
- IEEE Symposium on Computational Intelligence and Games
- IEEE Symposium on Computational Intelligence in Scheduling
- IEEE Symposium on Foundations of

Computational Intelligence

- IEEE Symposium on Computational Intelligence in Multicriteria Decision Making
- IEEE Symposium on Artificial Life
- IEEE Swarm Intelligence Symposium
- IEEE Symposium on Computational Intelligence in Security and Defense Applications
- IEEE Workshop on Evolvable and Adaptive Hardware

Honolulu, Hawaii, USA
April 1–5, 2007
Deadline for Paper Submissions: October 31, 2006
General Chair: David Fogel
www.ieee-ssci.org

Δ Conference on Integration of Knowledge Intensive Multi-Agent Systems: Modeling, Evolution, and Engineering

Boston, Massachusetts, USA
April 29–May 3, 2007
General Chair: Leonid Perlovsky
ieeeboston.org/kimas05.htm

Δ Atlantic Web Intelligence Conference

Fontainebleau, France
June 27–29, 2007
General Chair: Piotr Szczepaniak and Katarzyna Wegrzyn-Wolska
<http://www.awic2007.net>

* 2007 IEEE International Conference on Development & Learning

London, England
July 11–13, 2007

Deadline for Paper Submissions: N/A
General Chair: Yiannis Demiris
www.icdl07.org

Δ Symposium on Large Scale Systems

Gdansk, Poland
July 23–25 2007
General Chair: Mieczyslaw Brdys
www.ely.pg.gda.pl/lss2007/

* 2007 IEEE International Conference on Fuzzy Systems

London, England
July 23–26, 2007
Deadline for Paper Submissions: January 31, 2007
General Chair: Qiang Shen
www.fuzzIEEE2007.org

* 2007 International Joint Conference on Neural Networks

Orlando, Florida, USA
August 12–17, 2007
Deadline for Paper Submission: January 31, 2007
General Chair: Jennie Si
www.ijcnn2007.org

* 2007 IEEE Congress on Evolutionary Computation

Singapore, Singapore
September 25–28, 2007
Deadline for Paper Submissions: March 15, 2007
General Chairs: Tan-Kay Chen and Jian-Xin Xu
www.cec2007.org

Developmental Tools *(continued from page 51)*

your bug reports, suggestions and comments to EvoCoBR@cs.bham.ac.uk.

There are many things left to do in EvoCoBR; our future plan includes bibtext import, unique problem IDs, versioning ability, tutorials, etc. We would also like to extend EvoCoBR to cover the entire computational intelligence (CI) field.

We hope that EvoCoBR will be a useful resource for the CI community and that it will encourage and promote innovative research in years to come.

References

- [1] T. Bartz-Beielstein. *Experimental Research in Evolutionary Computation*. Springer Verlag, 2006.
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Birmingham and Honda Research Institute Europe GmbH, 2006.

- [3] D.J. Newman, S. Hettich, C.L. Blake, and C.J. Merz. UCI Repository of machine learning databases. <http://www.ics.uci.edu/~mllearn/MLRepository.htm>, University of California, Irvine, Dept. of Information and Computer Sciences, 1998.
- [4] L. Prechelt, Proben1—A Set of Neural Network Benchmarking Problems and Benchmarking Rules, <http://www.ubka.uni-karlsruhe.de/cgi-bin/psview?document=/ira/1994/21&search=/ira/1994/21>, Technical Report Nr. 21/ 94. Faculty of Computer Science, University of Karlsruhe, Germany, 1994.