

# MARCO AURELIO SOTELO FIGUEROA,

## PH.D., D.SC.

Full time professor in Guanajuato University.

Avenida de las Lomas 245, int 130, Irapuato, Guanajuato, México · (+52) 462 107 8768

[masotelo@ugto.mx](mailto:masotelo@ugto.mx), [masotelof@gmail.com](mailto:masotelof@gmail.com)

Scopus ID: 36601388800

---

### Education

#### PhD in D.SC.

“Cómputo Evolutivo aplicado al núcleo de las Hiperheurísticas para optimizar las Heurísticas generadas en el problema de empaçado”

National Technology of Mexico, 2016.

#### M.Sc. in Sc.

“Aplicación de metaheurísticas en el Knapsack Problem”

Leon Institute of Technology. 2010.

#### B.Sc. in CSE.

“Configuración de los servicios de DHCP y DDNS sobre un servidor Linux, permitiendo la interconexión entre Linux y Windows usando SAMBA”

Leon Institute of Technology, 2007.

# Publications

## Indexed Journal

**Grammatical evolution-based design of SARS-CoV-2 main protease inhibitors**, Physical Chemistry Chemical Physics, 2022. DOI: 10.1039/D1CP04159B

**Micro-differential evolution cluster-optimizer (MiDECO): an open-access software for the optimization of molecular clusters  $M \times N_z$  ( $x+ y \leq 5$ ;  $M= N$  or  $M \neq N$ )**, Journal of Nanoparticle Research, 2021, DOI: 10.1007/s11051-021-05205-5

**A novel model for optimization of Intelligent Multi-User Visual Comfort System based on soft-computing algorithms**, Journal of Ambient Intelligence and Smart Environments, 2021, DOI: 10.3233/AIS-210594

**A Methodology for Classifying Search Operators as Intensification or Diversification Heuristics**, Complexity, 2020. ISSN: 1076-2787 DOI: 10.1155/2020/2871835

**Evolutionary Design of Problem-Adapted Image Descriptors for Texture Classification**, IEEE Access, 2018. ISSN: 2169-3536. DOI: 10.1109/ACCESS.2018.2858660

**ePyNN: a low-cost embedded system for simulating Spiking Neural Networks**, 26th Annual Computational Neuroscience Meeting (CNS\*2017), 2017. ISSN: 1471-2202 DOI: 10.1186/s12868-017-0372-1.

**Evolvability metric estimation by a parallel perceptron for on-line selection hyper-heuristics**, IEEE Access, 2017. ISSN: 2169-3536. DOI: 10.1109/ACCESS.2017.2699426

**A methodology for determining an effective subset of heuristics in selection hyper-heuristics**, European Journal of Operational Research, 2017. ISSN: 0377-2217. DOI: 10.1016/j.ejor.2017.01.042

**Design of Spiking Central Pattern Generators for Multiple Locomotion Gaits in Hexapod Robots by Christiansen Grammar Evolution**, frontiers in Neurorobotics, 2016. ISSN: 1662-5218. DOI: 10.3389/fnbot.2016.00006.

**Quadrupedal Robot Locomotion: A Biologically Inspired Approach and Its Hardware Implementation**, Computational Intelligence and Neuroscience, 2016. ISSN: 1687-5273. DOI: 10.1155/2016/5615618.

**Improving the Bin Packing Heuristic through Grammatical Evolution Based on Swarm Intelligence**, Mathematical Problems in Engineering, Volume 2014. ISSN: 1024-123X. DOI: 10.1155/2014/545191 JCR Factor de impacto 1.082.

**A Comparison between Metaheuristics as Strategies for Minimizing Cyclic Instability in Ambient Intelligence**, Sensors, Volume 12, Issue 8, 2012. ISSN: 1424-8220. DOI: 10.3390/s120810990 JCR Factor de impacto 2.048.

## Journals

**Exploring Random Permutations Effects on the Mapping Process for Grammatical Evolution**, Journal of Automation, Mobile Robotics & Intelligent Systems, 2020. ISSN: 1897-8649.

**Application of Agglomerative and Partitional Algorithms for the Study of the Phenomenon of the Collaborative Economy Within the Tourism Industry**, Journal of Automation, Mobile Robotics & Intelligent Systems, 2020. ISSN: 1897-8649.

**Una comparativa de diferentes parámetros en la construcción evolutiva de descriptores para la clasificación de imágenes de texturas de piezas arqueológicas**, Research in Computing Science, 2018. ISSN: 1870-4069

**Gramatica Evolutiva con Estrategia Evolutiva como Núcleo de una Hiperheurística de Generación Aplicada al Problema de Empacado**, Research in Computing Science, 2017. ISSN: 1870-4069

**Evolución Diferencial con perturbaciones Gaussianas**, Research in Computing Science, 2015. ISSN: 1870-4069

**Algoritmos PESO y DE Aplicados al Problema de Inestabilidad en Sistemas Multiagentes Nómadas**, Programación Matemática y Software, 2013. ISSN: 2007-3283.

**Application of the bee swarm optimization BSO to the knapsack problem**, JAMRIS, Polonia, 2011. ISSN: 1897-8649.

## Book Chapters

**CMA Evolution Strategy Applied to Optimize Chemical Molecular Clusters  $M \times N_z$  ( $x+ y \leq 5$ ;  $M= N$  or  $M \leq N$ )**, New Perspectives on Hybrid Intelligent System Design based on Fuzzy Logic, Neural Networks and Metaheuristics, 2022. ISBN: 978-3-031-08265-8 DOI: 10.1007/978-3-031-08266-5\_18

**Performance Comparative Between Single and Multi-objective Algorithms for the Capacitated Vehicle Routing Problem**, New Perspectives on Hybrid Intelligent System Design based on Fuzzy Logic, Neural Networks and Metaheuristics, 2022. ISBN: 978-3-031-08265-8 DOI: 10.1007/978-3-031-08266-5\_10

**Studying Grammatical Evolution's Mapping Processes for Symbolic Regression Problems**, Intuitionistic and Type-2 Fuzzy Logic Enhancements in Neural and Optimization Algorithms: Theory and Applications, 2020. ISBN: 978-3-030-35445-9 DOI: 10.1007/978-3-030-35445-9\_32

**Comparative Analysis of Multi-objective Metaheuristic Algorithms by Means of Performance Metrics to Continuous Problems**, Intuitionistic and Type-2 Fuzzy Logic Enhancements in Neural and Optimization Algorithms: Theory and Applications, 2020. ISBN: 978-3-030-35445-9 DOI: 10.1007/978-3-030-35445-9\_37

**Direct and Indirect Evolutionary Designs of Artificial Neural Networks**, Intuitionistic and Type-2 Fuzzy Logic Enhancements in Neural and Optimization Algorithms: Theory and Applications, 2020. ISBN: 978-3-030-35445-9 DOI: 10.1007/978-3-030-35445-9\_31

**Spiking Central Pattern Generators through Reverse Engineering of Locomotion Patterns,** Cognitive and Computational Neuroscience: Principles, Algorithms and Applications, 2018. DOI: 10.5772/intechopen.72348

**Symbolic regression by means of grammatical evolution with estimation distribution algorithms as search engine,** Fuzzy Logic Augmentation of Neural and Optimization Algorithms: Theoretical Aspects and Real Applications, 2018. ISSN: 1860-949X. DOI: 10.1007/978-3-319-71008-2\_14

**Statistical Comparative Between Selection Rules for Adaptive Operator Selection in Vehicle Routing and Multi-knapsack Problems,** Fuzzy Logic Augmentation of Neural and Optimization Algorithms: Theoretical Aspects and Real Applications, 2018. ISSN: 1860-949X. DOI: 10.1007/978-3-319-71008-2\_28

**Iterated VND Versus Hyper-heuristics: Effective and General Approaches to Course Timetabling,** Nature-Inspired Design of Hybrid Intelligent Systems, 2017. ISSN: 1860-949X. DOI: 10.1007/978-3-319-47054-2\_45

**Differential Evolution with Self-adaptive Gaussian Perturbation,** Nature-Inspired Design of Hybrid Intelligent Systems, 2017. ISSN: 1860-949X. DOI: 10.1007/978-3-319-47054-2\_40

**Generating Bin Packing Heuristic Through Grammatical Evolution Based on Bee Swarm Optimization,** Nature-Inspired Design of Hybrid Intelligent Systems, 2017. ISSN: 1860-949X. DOI: 10.1007/978-3-319-47054-2\_43

**Evolutionary Indirect Design of Feed-Forward Spiking Neural Networks,** Design of Intelligent Systems Based on Fuzzy Logic, Neural Networks and Nature-Inspired Optimization, 2015. ISSN: 1860-949X ISBN: 978-3-319-17746-5 DOI: 10.1007/978-3-319-17747-2\_7

**Parallel Meta-heuristic Approaches to the Course Timetabling Problem,** Design of Intelligent Systems Based on Fuzzy Logic, Neural Networks and Nature-Inspired Optimization, 2015. ISSN: 1860-949X ISBN: 978-3-319-17746-5 DOI: 10.1007/978-3-319-17747-2\_30

**Clustering Bin Packing Instances for Generating a Minimal Set of Heuristics by Using Grammatical Evolution** Fuzzy Logic Augmentation of Nature-Inspired Optimization Metaheuristics, 2015. ISSN: 1860-949X. ISBN: 978-3-319-10959-6. DOI: 10.1007/978-3-319-10960-2\_10.

**Comparing Metaheuristic Algorithms on the Training Process of Spiking Neural Networks**, Recent Advances on Hybrid Approaches for Designing Intelligent Systems, 2014. ISSN: 1860-949X. ISBN: 978-3-319-05169-7. DOI: 10.1007/978-3-319-05170-3\_27.

**Generic Memetic Algorithm for Course Timetabling ITC2007**, Recent Advances on Hybrid Approaches for Designing Intelligent Systems, 2014. ISSN: 1860-949X. ISBN: 978-3-319-05169-7. DOI: 10.1007/978-3-319-05170-3\_33.

**Comparison of Metaheuristic Algorithms with a Methodology of Design for the Evaluation of Hard Constraints over the Course Timetabling Problem**, Recent advances on hybrid intelligent systems, 2013. ISSN: 1860-949X. ISBN: 978-3-642-33020-9. DOI: 10.1007/978-3-642-33021-6\_23.

**Evolving Bin Packing Heuristic Using Micro-Differential Evolution with Indirect Representation**, Recent advances on hybrid intelligent systems, 2013. ISSN: 1860-949X. ISBN: 978-3-642-33020-9. DOI: 10.1007/978-3-642-33021-6\_28.

**Methodology of Design: A Novel Generic Approach Applied to the Course Timetabling Problem**, Soft Computing Applications in Optimization, 2013. ISSN: 1434-9922. ISBN: 978-3-642-35322-2. DOI: 10.1007/978-3-642-35323-9\_12.

**Comparative Study of BSO and GA for the Optimizing Energy in Ambient Intelligence**, Advances In Soft Computing, Springer Berlin / Heidelberg, 2011. ISSN: 0 302-9743. ISBN: 978-3-642-25329-4. DOI: 10.1007/978-3-642-25330-0\_16.

**Application of the Bee Swarm Optimization BSO to the Knapsack Problem**, Soft Computing for Recognition Based on Biometrics, Springer Berlin / Heidelberg, 2010. ISSN: 1860-949X. ISBN: 978-3-642-15110-1. DOI: 10.1007/978-3-642-15111-8\_12.

## Congress

**Developing Architectures of Spiking Neural Networks by Using Grammatical Evolution Based on Evolutionary Strategy**, 6th Mexican Conference on Pattern Recognition (MCPR) 2014. ISSN: 0302-9743. ISBN: 978-3-319-07490-0. DOI: 10.1007/978-3-319-07491-7\_8.

**Evolving and reusing Bin Packing heuristic through Grammatical Differential Evolution**, Nature and Biologically Inspired Computing (NaBIC), 2013. ISBN: 978-1-4799-1414-2. DOI: 10.1109/NaBIC.2013.6617844.

**A Comparative Study of Intelligent Bio-inspired Algorithms Applied to Minimizing Cyclic Instability in Intelligent Environments**, The 8th International Conference on Intelligent Environments (IE'12) 2012. ISBN: 978-1-61499-079-6. DOI: 10.3233/978-1-61499-080-2-130.

**Algoritmos PSO y PESO aplicados al problema de inestabilidad dinámica en sistemas multiagentes nómadas**, XIV Reunión de Otoño de Potencia, Electrónica y Computación 2012. ISBN: 978-607-95476-6-0.

**Applying Adapted PSO Approach to Minimize Costs in the Beer Distribution Game Using Three Dynamic Demand Patterns**, CERMA, 2012. ISBN: 978-0-7695-4878-4. DOI: 10.1109/CERMA.2012.34.

**A comparison between PSO and MIMIC as strategies for minimizing cyclic instabilities in ambient intelligence**, 5th International Symposium on Ubiquitous Computing and Ambient Intelligence (UCAmI'11), 2011. ISBN: 978-84-694-9677-0.

**Comparison of PSO and DE for training neural networks**, MICAI 2011, Puebla, Puebla. ISBN: 978-1-4577-2173-1. DOI: 10.1109/MICAI.2011.16.

**A comparison between Bee Swarm Optimization and Greedy Algorithm for the Knapsack Problem with bee reallocation**, MICAI 2010, Pachuca, Hidalgo. ISBN: 978-0-7695-4284-3. DOI: 10.1109/MICAI.2010.32.

**Migración de la solución del Knapsack Problem usando Metaheurísticas para su ejecución en dispositivos móviles**, CIINDET, Cuernavaca Morelos, 2010. ISBN: 978-607-95255-2-1.

**Aplicación de un Reparador Cromosómico al PSO y GA para la solución del problema de las n-Reinas**, CIINDET, Cuernavaca Morelos, 2010. ISBN: 978-607-95255-2-1.

**Aplicación de un PSO para la optimización de parámetros de un ACS aplicado al TSP**, Décima Primera Reunión de Otoño de Potencia, Electrónica y Computación del IEEE, XI ROPEC, Morelia 2009

## Awards and Recognitions

SNI Level I

PRODEP Profile.

First place in the National Postgraduate Thesis Contest 2011 (M.Sc)

(<http://www.dgest.gob.mx/academicas/se-realizo-la-premiacion-del-septimo-concurso-nacional-de-tesis-de-posgrado>)

## Referees

Prof. Oscar Castillo López, PhD.

Tijuana Institute of Technology, [ocastillo@tectijuana.mx](mailto:ocastillo@tectijuana.mx)

Prof. Patricia Melin, PhD.

Tijuana Institute of Technology, [pmelin@tectijuana.mx](mailto:pmelin@tectijuana.mx)

Prof. Arturo Hernández Aguirre, PhD.

Center for Research in Mathematics, [artha@cimat.mx](mailto:artha@cimat.mx)



## **Previous Work.**

In my Ph.D. I worked with generative hyper-heuristics focused to generate bin-packing heuristics using Grammatical Evolution as the hyper-heuristic core. I studied the impact to change the search engine of the Grammatical Evolution with the hyper-parameters optimized and the conclusions were published in the Journal "Mathematical Problems in Engineering". With this work, it started to use Grammatical Evolution as Hyper-Heuristics and before it the Genetic Programming was used but was necessary to control the introns and this problem was handled with the mapping process.

This work led me to collaborate interdisciplinary with robotics, chemistry, and the Grammatical Evolution fields.

In the robotics field, a Spiking Central Pattern was designed using generative hyper-heuristics with a Christiansen Grammar, with this grammar included the problem's semantics.

Grammatical Evolution has been one of my research fields, and due to the importance of generative hyper-heuristics, I have been working to contribute to improving it. Most of my current papers are based to improve the mapping process, I'm writing a paper with the results to change the optimization problem into the Grammatical Evolution, and It has really been used in other fields like pattern recognition and chemistry.

The last work using Grammatical Evolution originally wanted to generate a hyper-heuristic to the design of SARS-CoV-2 main protease inhibitors, but the computer time used allowed only to work with the original SARS-CoV-2 main protease instead of the SARS-CoV2 variants.

In these investigations was not used a multiobjective metaheuristic, however, sometimes it was a preliminary multiobjective function handled by a weighted sum of the many objectives. With the work of Grammatical Evolutions is possible to change it by a multiobjective metaheuristic like NSGA-II or a MOED.

## **Research Interests.**

My research interests are:

- Evolutive algorithms.
- Numerical Optimization.
- Bilevel Optimization.
- Generative Hyper-Heuristics.
- Parallel implementations of Heuristics, Metaheuristics, and Hyper-Heuristics.
- Solving multidisciplinary problems using AI and HPC.

## **Future vision on the field.**

The hyper-heuristics concept can be applied to many kinds of problems, and it's very interesting to generate a way to solve them. Traditionally hyper-heuristics can be used to generate a heuristic but it is also possible to generate Artificial Neural Networks, Central Pattern Generators, Protease Inhibitors, Chemical molecules, et al.

The multiobjective can be used together with a generative hyper-heuristic to define several objectives to comply with the hyper-heuristic process and that allows to have heuristics or solutions more suitable to the problem.

Grammatical Evolution can be applied with a multiobjective approach as an engine search to use in the generative hyper-heuristics. The context is very important and sometimes it can be included using grammar that incorporates some elements like semantics.

Due to the computational cost to compute generative hyper-heuristics is necessary to prepare computer programs to use multicore paradigms or to use high-performance computing.