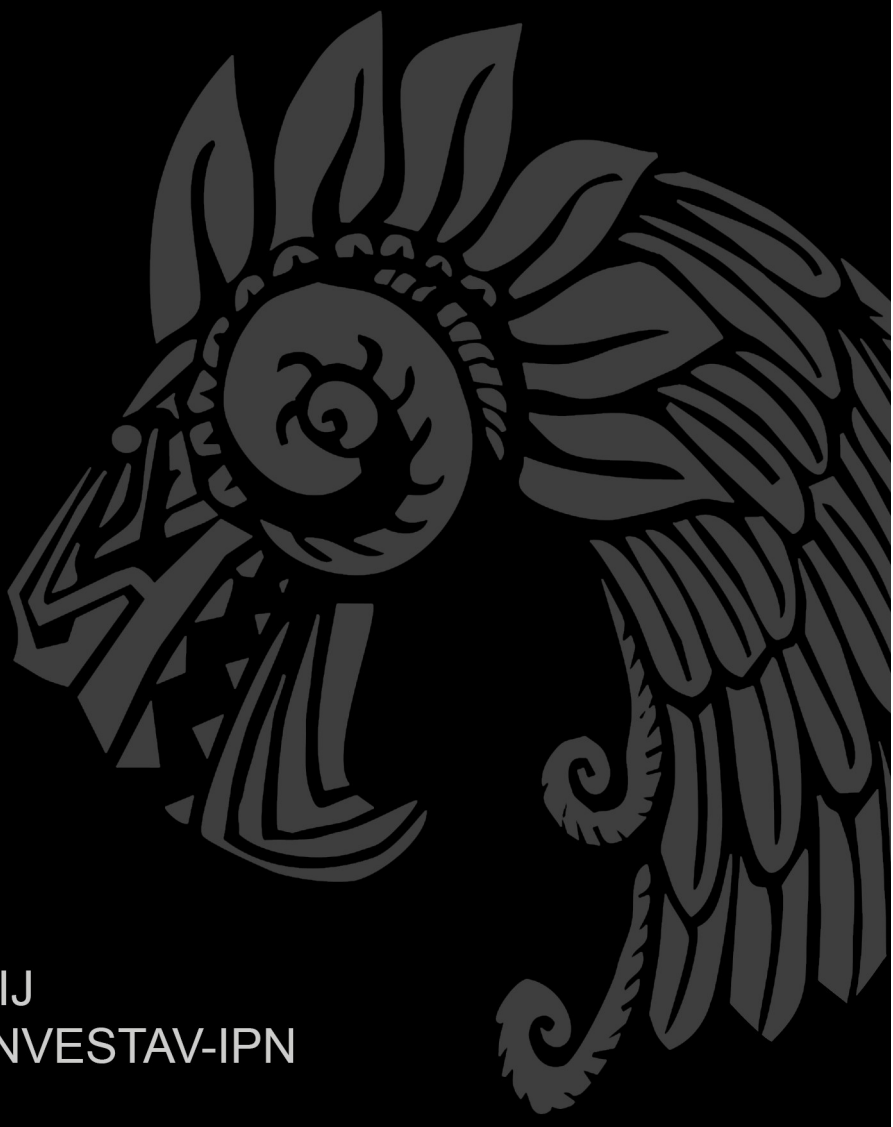
8th International Workshop on Numerical and Evolutionary Optimization

November 18 and 19, 2020



General Chairs:
Juan Gabriel Ruiz Ruiz, UNSIJ
Luis Gerardo de la Fraga, CINVESTAV-IPN

Contents

Foreword

Welcome

Welcome to the 8th International Workshop on Numerical and Evolutionary Optimization (NEO 2020, NEO Energy) which will be held as online only event caused by the current Covid-19 pandemic. While the NEO 2020 welcomes all contributions to numerical and evolutionary optimization, the main focus of this years' edition is on optimization aspects related to energy.

Fist to all, we would like to express our gratitude to all that made it possible to realize the NEO 2020: Keynote and Tutorial Speakers, presenters, students, organizers, and reviewers.

This year, we will have 4 keynote talks, 3 regular tutorials and another 3 tutorials targeting at undergraduate students, and 48 contributed talks those presenters come from Mexico, Germany, China, and the United States of America. The event will be held during two days with up to three parallel sessions.

As a satelite event, we will again have the Research Experience Day (RED, organized by Salvador Enrique Lobato Larios) that targets at undergraduate students who are interested in starting a career in research, in particular in the fields of Energy and/or Optimization. Further, we will also again have the session Women at NEO (organized by Adriana Lara and Marcela Quiroz) which is a platform to encourage the presence of women in Science, in particular, in Numerical and Evolutionary Optimization and Computing.

We thank you again in your participation at the NEO 2020, and hope that you will enjoy the event.

Juan Gabriel Ruiz Ruiz, UNSIJ, Oaxaca, Mexico
Luis Gerardo de la Fraga, Cinvestav-IPN, Mexico City, Mexico,
NEO 2020 General Chairs

Acknowledgments

We want to thank all participants that helped to make the NEO 2020 such a great success. In particular, we would like to thank Keynote Speakers: Ling Hong (Xi'an Jiaotong University, China), Kalyanmoy Deb (Michigan State University, USA), Iván Salgado Tránsito (AC Optics Research Center, Mexico), and Jian-Qiao Sun (UC Merced, USA). As well as Tutorial Speakers: Marcela Quiroz (CIIA-UV), Jesús-Adolfo Mejía-de-Dios, Efrén Mezura-Montes (CIIA-UV), Guillermo Morales-Luna (CINVESTAV-IPN), Luis Gerardo De la Fraga (CINVESTAV-IPN), Yazmin Maldonado Robles (ITT), Claudia Sánchez and Mario Graff (INFOTEC). We also thank Session Chairs: Adriana Lara (ESFM-IPN), Marcela Quiroz (CIIA-UV), Luis Gerardo De la Fraga (CINVESTAV-IPN), Rafael Campos Amezcua (CENIDET), Oliver Cuate (CINVESTAV-IPN), Iván Salgado Tránsito (Optical Research Center) and Oliver Schütze (CINVESTAV-IPN). Further, we gratefully acknowledge financial support from the Basic Science Group Project No. 285599, from the publisher MDPI, from the Nuclear Power Institute of China (NPIC), and the following institutions: CINVESTAV-IPN, Universidad de la Sierra Juárez and Universidad Veracruzana for supporting the organization of NEO 2020. Finally, we would like to thank all the persons without whom the NEO 2020 would not have been made possible: the staff members Felipa Rosas and Erika Rios from the CINVESTAV-IPN, and the student Guadalupe Carmona Arroyo (CIIA-UV). We would like to express our special thanks to Impakt 45 S.A. de C.V. who made an amazing job to make all the arrangements for the NEO 2020.

Partners

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Schedule

Schedule NEO 2020

DAY 1, NOVEMBER 18, 2020	
	ROOM 1
08:45 - 09:00	**Opening RED** (for attendees of the Research Experience Day)
09:30 – 10:30	**Tutorial I: Yazmín Maldonado Robles** **VHDL by MOEA** Chair: Salvador Enrique Lobato Larios
11:45 – 12:25	**Career Opportunity I: Guillermo Morales-Luna** **Graduate Studies in CS at Cinvestav-IPN: Offers and Opportunities for Mexican and Foreign Students** Chair: Salvador Enrique Lobato Larios
12:30 – 13:10	**Career Opportunity II: Marcela Quiroz** **Artificial Intelligence: Opportunities for Students in AI at Universidad Veracruzana** Chair: Salvador Enrique Lobato Larios
15:45 – 17:25	**Session Applications** (4 talks)
17:45 – 18:45	**Tutorial III: Luis Gerardo de la Fraga** **Optimization using Python** Chair: Salvador Enrique Lobato Larios
	ROOM 2
9:00 – 9:30	**Opening** (for all NEO attendees)
9:30 – 10:20	**Session Optimization in Industry I** (2 talks)
10:30 – 11:30	**Keynote I: Kalyanmoy Deb** **Evolutionary Multi-Criterion Optimization: Three Decades of Research and Applications** Chair: Oliver Schütze
11:45 – 13:25	**Session Set Oriented Numerics** (4 talks)
14:30 – 15:30	**Keynote II: Jian-Qiao Sun** **Ultra-High Density Piezoelectric Energy Harvesting System from Highway Traffic** Chair: Oliver Schütze
15:45 – 17:00	**Session Optimization in Industry II** (3 talks)
17:15 – 18:15	**Tutorial II: Claudia Sánchez and Mario Graff** **Wind Data Analysis and Data Imputation using Classical and Machine Learning Techniques** Chair: Carlos Hernandez
20:00 – 22:00	**Women at NEO**
	ROOM 3
09:30 – 10:20	**Session Circuits and Machine Learning I** (2 talks)
11:45 – 13:25	**Session Circuits and Machine Learning II** (4 talks)
15:45 – 17:00	**Session Solar Energy** (3 talks)
17:15 – 18:30	**Session Discrete Optimization I** (3 talks)
DAY 2, NOVEMBER 19, 2020	
	ROOM 1
9:00 – 10:00	**Keynote III: Ling Hong** **Evolutionary Dynamics and Bifurcations in Nonlinear Dynamical Systems with Fuzzy Uncertainties** Chair: Oliver Schütze
10:15 – 11:55	**Session Multi-objective Optimization** (4 talks)
12:15 – 13:30	**Session Decision Making I (**3 talks)
14:30 – 15:30	**Keynote IV: Ivan Salgado Transito** **Thermal Solar Energy, a Solution for a more Sustainable Future** **C**hair: Luis Gerardo de la Fraga
15:45 – 16:35	**Session Decision Making II** (2 talks)
17:10 – 17:30	**Closing Session**
	ROOM 2
9:00 – 10:00	**Tutorial IV: Jesús-Adolfo Mejía-de-Dios and Efrén Mezura-Montes** **Bilevel Optimization Without Tears** Chair: Juan Gabriel Ruiz Ruiz
10:15 – 11:55	**Session Wind Energy** (4 talks)
12:15 – 13:30	**Session Discrete Optimization II (**3 talks)
15:45 – 17:00	**Session Discrete Optimization III** (3 talks)

Schedule Sessions NEO 2020

DAY 1, NOVEMBER 18, 2020				
	ROOM 1	**ROOM 2**	**ROOM 3**	
		Session Optimization in Industry I Time: 09:30 – 10:20 Chair: Oliver Cuate	**Session Circuits and Machine Learning I** Time: 09:30 – 10:20 Chair: Luis Gerardo de la Fraga	**50 minutes**
09:30 - 09:55		**Lu Jiang and Furui Xiong.** Numerical Simulation and Optimization on Sealing Performance of the Spring Energized C-ring in Reactor Pressure Vessel	**Perla Rubi Castañeda, Esteban Tlelo Cuautle and Luis Gerardo de la Fraga.** Single-objective Optimization of a CMOS VCO Considering Monte Carlo Simulation	
09:55 - 10:20		**Yuanlin Li, Li Cheng and Tao Bai.** HySim: Co-simulation Platform and its Engineering Application in Multidisciplinary Optimization Design	**Luis Gerardo de la Fraga** Data Types in a Supervised Learning Application	
		Session Set Oriented Numerics Time: 11:45 – 13:25 Chair: Lourdes Uribe	**Session Circuits and Machine Learning II** Time: 11:45 – 13:25 Chair: Luis Gerardo de la Fraga	**1 hour, 40 minutes**
11:45 - 12:10		**Bennet Gebken and Sebastian Peitz** An efficient descent method for locally Lipschitz multiobjective optimization problems	**Lucía J. Hernández-González, Juan Frausto-Solís, J. Javier González-Barbosa, José Enrique Olvera Vazquez, Juan Paulo Sánchez-Hernández and Edgar Roman-Rangel** Forecasts for confirmed Covid cases using CNN, ARIMA and Exponential Smoothing	
12:10 - 12:35		**Leonardo Guerrero, Diana Gamboa and Rosana Gutierrez** Mathematical Analysis for a Nonlinear Type 1 Diabetes Mellitus Model	**Youness El Hamzaoui and Juan Antonio Alvarez Arellano** Optimization of Operating Conditions for Hydraulic Concrete Structures using an Artificial Neural Networks Inverse	
12:35 - 13:00		**Salvador Botello-Aceves, S. Ivvan Valdez and Arturo Hernandez Aguirre** Difficulties of a local transformation for multi-objective optimization problems: Is it worth it?	**Guadalupe Castilla Valdez, Juan Frausto Solis, Moises Israel Herrera Ramos, Juan Javier González-Barbosa and Leonor Hernandez Ramirez** A Neuroevolutionary Forecasting Algorithm for Time Series with Genetic and Simulated Annealing Algorithms	
13:00 - 13:25		**Lourdes Uribe, Johan M Bogoya, Andrés Vargas, Adriana Lara, Guenter Rudolph and Oliver Schuetze** A Set Based Newton Method in the Δp Sense	**Martín Alejandro Valencia Ponce, Esteban Tlelo Cuautle and Luis Gerardo de la Fraga** Multi-objective optimization of a CMOS OTA's linearity for chaotic oscillators	
	Session Applications Time: 15:45 – 17:25 Chair: Yazmin Maldonado	**Session Optimization in Industry II** Time: 15:45 – 17:00 Chair: Oliver Cuate	**Session Solar Energy** Time: 15:45 – 17:00 Chair: Iván Salgado-Tránsito	**1 hour, 40 minutes**
15:45 - 16:10	**Natan Vilchis-Tavera and Adriana Lara** A Genetic Algorithm to Effectively Design Musical Counterpoints	**David Laredo Razo** Optimizing the Operating Personnel Costs (OPC) at Bosch's Toluca plant	**Víctor Ramos Fon Bon, Roberto Hourcio Albores Arzate, Manuel De Jesús Palacios Gallegos, Edalí Camacho Ruiz, Cristina Blanco González and Aremi Olaya Virrueta Gordillo** Generation of virtual maps of the solar resource in the State of Chiapas, México	
16:10 - 16:35	**Josué Gómez, América Morales and Chidentree Treesatayapun** Comparison between classical model and data driven model of the first order kinematic control for a redundant robot	**Carlos Ignacio Hernandez Castellanos, Sina Ober-Blöbaum and Sebastian Peitz** Explicit Multi-objective Model Predictive Control for Nonlinear Systems Under Uncertainty	**Fernando Moreno Gomez and Adriana Lara** Optimizing Roof-gardens Location for Mexico City Air Quality Improvement	
16:35 - 17:00	**Salvador Lobato and Juan Gabriel Ruiz** Optimizing the energy for an industrial robotic arm manipulator using Particle Swarm Optimization algorithm	**Youness El Hamzaoui, Juan Antonio Alvarez Arellano and J.A Rodriguez** Modeling of a Steam Turbine through Neural Network Training using Genetic Algorithms	**Esmeralda López-Garza, René Domínguez-Cruz and Iván Salgado-Tránsito** Optimization management for electric power grids based on a linear model	
17:00 - 17:25	**Rogelio Valdez and Yazmin Maldonado** FPGAS as efficient accelerators for the implementation of heterogeneous computing.			
			Session Discrete Optimization I Time: 17:15 – 18:30 Chair: Marcela Quiroz	**1 hour, 15 minutes**

17:15 - 17:40			**Héctor Fraire-Huacuja, Daniela López-García, Laura Cruz-Reyes, Nelson Rangel-Valdez, Claudia Guadalupe Gómez-Santillán, María Lucila Morales-Rodríguez and Fausto Antonio Balderas Jaramillo** Optimization of the Project Selection Multi-objective Problem with Type Interval Fuzzy Parameters	
17:40 - 18:05			**Leo Hernández-Ramirez, Juan Frausto-Solis, Guadalupe Castilla-Valdez, Javier González-Barbosa and Juan Paulo Sánchez-Hernández** Chaotic Multi-Objective Simulated Annealing and Threshold Accepting for Job Shop Scheduling Problem	
18:05 - 18:30			**Octavio Ramos-Figueroa and Marcela Quiroz-Castellanos** An Experimental Study of Grouping Mutation Operators for the Unrelated Parallel-Machine Scheduling Problem	

Schedule Sessions NEO 2020

DAY 2, NOVEMBER 19, 2020			
	R O O M 1	**R O O M 2**	
	Session Multi-Objective Optimization Time: 10:15 – 11:55 Chair: Antonin Ponsich	**Session Wind Energy** Time: 10:15 – 11:55 Chair: Rafael Campos Amezcua	**1 hour, 40 minutes**
10:15 - 10:40	**Katharina Bieker, Bennet Gebken and Sebastian Peitz** On the treatment of optimization problems with L1 penalty terms via multiobjective continuation	**Josué Jordi Zavala, Erasmos Cadenas and Rafael Campos** Optimal design of a wind turbine blade based on its mass, in the domain of stress and tip speed ratio	
10:40 - 11:05	**Manuel Berkemeier and Sebastian Peitz** Derivative-Free Multiobjective Trust Region Descent Method Using Radial Basis Function Surrogate Models	**Alma Rosa Méndez Gordillo, Rafael Campos Amezcua and Erasmo Cadenas Calderón** Existence of multifractality in wind speed time series	
11:05 - 11:30	**Carlos Hernandez and Oliver Schütze** Archiving Strategies for Multi-objective Evolutionary Algorithms	**Julio Cesar Solís Sánchez, Manuel De Jesús Palacios Gallegos, Roberto Hourcio Albores Arzate, Cristina Blanco González, Edalí Camacho Ruiz, Víctor Ramos Fon Bon, Aremi Olaya Virrueta Gordillo and Josué Chanona Soto** Development of a methodology to optimize low-power wind energy harvesting	
11:30 - 11:55	**Antonin Ponsich, Bruno Domenech, Laia Ferrer-Martí, Alberto García-Villoria and Rafael Pastor** Comparison of archive pruning strategies for the multi-objective optimization of stand-alone electrification systems	**Marcos Hernández Ortega, Rafael Campos Amezcua, Roberto Gomez Martinez, Hugo Abundis Fong, Luis Gerardo Trujillo Franco and Luis Manuel Palacios Pineda** Numerical and experimental analysis of the near wake behind a small wind turbine rotor	
	Session Decision Making I Time: 12:15 – 13:30 Chair: Juan Gabriel Ruiz Ruiz	**Session Discrete Optimization II** Time: 12:15 – 13:30 Chair: Marcela Quiroz	**1 hour, 15 minutes**
12:15 - 12:40	**Oliver Cuate and Oliver Schütze** Pareto Explorer for Finding the Knee for Many Objective Optimization Problems	**Claudia Orquídea López Soto, Emiliano Traversi and David Chaffrey Moreno Fernández** Core problem based heuristics for the probabilistic revenue management problem	
12:40 - 13:05	**Mercedes Perez-Villafuerte, Laura Cruz-Reyes, Nelson Rangel-Valdez, Claudia Gomez-Santillan and Hector Joaquin Fraire** Effect of the profile of the decision maker in the search for solutions in the decision-making process	**Joel Chacón Castillo and Carlos Segura González** A Variant of Differential Evolution with Enhanced Diversity Maintenance	
13:05 - 13:30	**Teodoro Macias-Escobar, Laura Cruz-Reyes, Cesar Medina-Trejo, Claudia Gomez-Santillan, Nelson Rangel-Valdez and Hector Fraire** Interactive recommendation system for the multiobjective project portfolio problem based on the characterization of cognitive tasks	**Guadalupe Carmona Arroyo, Marcela Quiroz Castellanos and Efrén Mezura Montes** Variable Decomposition for Large-scale Constrained Optimization Problems Using a Grouping Genetic Algorithm	
	Session Decision Making II Time: 15:45 – 16:35 Chair: Juan Gabriel Ruiz Ruiz	**Session Discrete Optimization III** Time: 15:45 – 17:00 **Chair: Marcela Quiroz**	**1 hour, 15 minutes**

15:45 - 16:10	**José Yaír Guzmán-Gaspar, Efrén Mezura-Montes and Saúl Domínguez-Isidro** Differential Evolution in Robust Optimization Over Time: Survival Time Approach	**Xochitl Samantha Delgado Hernández, María Lucila Morales Rodriguez and Nelson Rangel Valdez** Optimization of Phrase Selection for a Conversational Virtual Agent through Speech Acts and Outranking Methods	
16:10 - 16:35	**Juan Gabriel Ruiz Ruiz and Salvador Enrique Lobato Larios** Optimization of the Design of a Website Using an Interactive Genetic Algorithm	**Juan Frausto, Juan Javier González Barbosa, Guadalupe Castilla Valdez, Jose Luis Purata Aldaz, Diego Soto Monterrubio and Leonor Hernández Ramirez** GenPo Sharpe: Stock Selection for Investing Portfolio using a Genetic Algorithm with Sharpe Ratio Applied to Mexican Stock Exchange	
16:35 - 17:00		**Jessica Elena Gonzalez San Martin, Laura Cruz Reyes, Bernabé Dorronsoro, Marcela Quiroz Castellanos, Nelson Rangel Valdez, Claudia Guadalupe Gómez Santillán and Héctor Fraire Huacuja** The Bin Packing Optimization Problem: Algorithm Analysis and Open Problems	

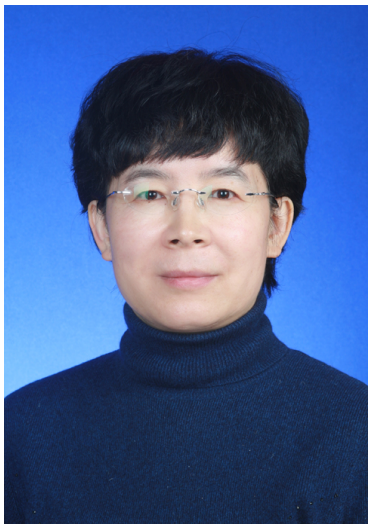
II Invited Speakers

Ling Hong

Evolutionary Dynamics and Bifurcations in Nonlinear Dynamical Systems with Fuzzy Uncertainties

Xi'an Jiaotong University, China

Talk Abstract



Responses and bifurcations of nonlinear dynamical systems with fuzzy uncertainties are studied by means of the Fuzzy Generalized Cell Mapping (FGCM) method. A rigorous mathematical foundation of the FGCM is established as a discrete representation of the fuzzy master equation for the possibility transition of continuous fuzzy processes. The FGCM offers a very effective approach for solutions to the fuzzy master equation based on the min–max operator of fuzzy logic. A fuzzy response is characterized by its topology in the state space and its possibility measure of membership distribution functions (MDFs). A fuzzy bifurcation implies a sudden change both in the topology and in the MDFs. The response topology is obtained based on the qualitative analysis of the FGCM involving the Boolean operation of 0 and 1. The MDFs are determined by the quantitative analysis of the FGCM with the min–max calculations. With an increase of the intensity of fuzzy noise, noise-induced escape from each of the potential wells (attractors) defines two types of bifurcations, namely catastrophe and explosion. This talk focuses on the evolution of transient and steady-state MDFs of the fuzzy response. As the intensity of fuzzy noise increases, steady-state MDFs cover a bigger area in the state space with higher membership values spreading out to a larger area. The previous conjectures are further confirmed that steady-state MDFs are dependent on initial possibility distributions due to the nonsmooth and nonlinear nature of the min–max operation. It is found that as time goes on, transient MDFs spread around stable invariant sets. The evolutionary orientation of transient MDFs aligns with unstable invariant manifolds leading to stable invariant sets. Two examples of additive and multiplicative fuzzy noise are given.

Short Biography

Dr. Ling Hong is currently a professor in the School of Aerospace at Xi'an Jiaotong University. She serves as the Associate Editor of International Journal of Dynamics and Control published by Springer. Dr. Ling Hong earned her PhD from Xi'an Jiaotong University in 2001. She worked as a postdoctoral fellow at the University of Delaware in USA from 2004 to 2006. She was awarded the National Nature Science Award in 2003 and nominated for 'The Best 100 PhD Theses of China' in 2004. Her research area is nonlinear dynamics and control focusing on global dynamics, bifurcations and chaos. The following are her research projects from NSFC that she has currently been working: (1) Study on Evolutionary Dynamics of Transient Responses and Membership Distribution Functions for Fuzzy Nonlinear Systems (PI from 2017 to 2020) (2) Study on Analysis Methods and Phenomena Mechanisms for Dynamics of Fuzzy Non-smooth Systems (PI from 2020 to 2023). More information about her research contribution can be found from http://gr.xjtu.edu.cn/web/hongling.

Kalyanmoy Deb

Evolutionary Multi-Criterion Optimization: Three Decades of Research and Applications

Michigan State University

Talk Abstract

Started in early nineties, multi-objective optimization problems were solved without any prior preference information. Evolutionary computation methods were minimally modified to search and store multiple Pareto-optimal solutions simultaneously within an evolving population. The basic idea has not changed in the past three decades, but it has been extended, perfected, and applied to various fields of science, society, engineering, and business. This lecture will present a chronological account of key events and research inventions which propelled the evolutionary multi-objective optimization (EMO) into a field which many novice and expert researchers and applicationists now proudly call it their profession.

Short Biography

Kalyanmoy Deb is Koenig Endowed Chair Professor at Department of Electrical and Computer Engineering in Michigan State University, USA. Prof. Deb is a pioneer and has been an active proponent of EMO field since 1994. Prof. Deb's research interests are in evolutionary optimization and their application in multi-criterion optimization, modeling, and machine learning. He has been a visiting professor at various universities across the world including IITs in India, Aalto University in Finland, University of Skovde in Sweden, Nanyang Technological University in Singapore. He was awarded IEEE Evolutionary Computation Pioneer Award, Infosys Prize, TWAS Prize in Engineering Sciences, CajAstur Mamdani Prize, Distinguished Alumni Award from IIT Kharagpur, Edgeworth-Pareto award, Bhatnagar Prize in Engineering Sciences, and Bessel Research award from Germany. He is fellow of IEEE, ASME, and three Indian science and engineering academies. He has published over 520 research papers with Google Scholar citation of over 137,000 with h-index 116. He is in the editorial board on 20 major international journals. More information about his research contribution can be found from https://www.coin-lab.org.

Iván Salgado Tránsito

Thermal solar energy, a solution for a more sustainable future

AC Optics Research Center

Talk Abstract

The talk will present a brief overview of the relevance of solar power technology, its potential to transform the global energy system and become into the main energy source in the next century. We will focus on solar thermal technology for electricity generation also call Concentrating Solar Power (CPS). This technology use optical mirrors or lens to concentrate solar radiation in a focal point where a fluid is heated up, then, electricity is generated in a conventional thermodynamic power cycle. CPS has the enormous advantage of having low-cost energy storage systems becoming it in a stabilizing key source in distributed power generation networks dominated by other fluctuating renewable energy sources as wind and solar PV. Finally, some of the niches of opportunity for optimization of power grid with distributed generation will succinctly presented.

Short Biography

Research Fellow in Solar Energy, Member of Mexican National Research System level − 1. Bachelor degree in Mechanical Engineer and MSc. & D.Eng in Solar Energy from the National Autonomous University of Mexico. Postdoc at the Solar Energy Laboratory of the University of Minnesota, US. Member of TAKS 49 − Solar Heat Integration in Industrial Processes (IEA) and the Mexican Heat Initiative. He has done two research stays, one in the Almeria Solar Platform and the other in the Faculty of Mathematics at the University of Basque Country. He serves as Assistant Professor at the University of Sonora working in the Heliostats Test Field in Hermosillo, Mexico. He is currently a Research Fellow at The Optical Research Center (CIO, Spanish abbreviation); His main achievements are the foundation of the Solar Energy Research & Engineering Group and the establishment of The Thermal Energy and Photovoltaic Evaluation Lab (LICS−TF). More information about his research contribution can be found from https://www.cio.mx/investigadores/ivan_salgado.

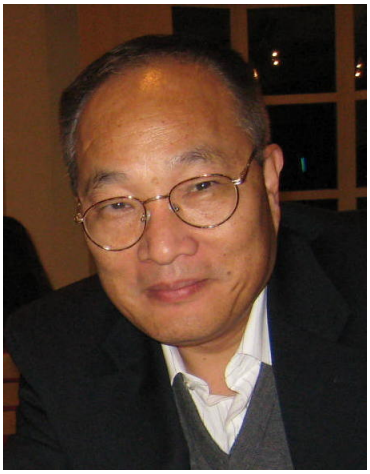
Jian-Qiao Sun

Ultra-High Density Piezoelectric Energy Harvesting System from Highway Traffic

UC Merced

Talk Abstract

In this talk, we shall report the project progress and results of piezoelectric energy harvesting from highway traffic. The project is supported by California Energy Commission. We shall review the background of the project, the objectives, device design and experimental evaluations. Finally, we report the projection of energy production by the proposed piezoelectric energy technology over a mile-long highway. The scale of the possible energy production using piezoelectric materials is the largest one reported in the literature at this time.



Short Biography

Dr. Jian-Qiao Sun earned a BS degree in Solid Mechanics from Huazhong University of Science and Technology in Wuhan, China in 1982, and a PhD in Mechanical Engineering from University of California at Berkeley in 1988. He worked for Lord Corporation at their Corporate R&D Center in Cary, North Carolina. Dr. Sun jointed the faculty in the department of Mechanical Engineering at the University of Delaware as an Assistant Professor in 1994, was promoted to Associate Professor in 1998 and to Professor in 2003. He joined University of California at Merced in 2007, and is currently a professor and chair of the Department of Mechanical Engineering in School of Engineering. He is currently the Editor-in-Chief of International Journal of Dynamics and Control published by Springer. More information about his research contribution can be found from https://www.ucmerced.edu/content/jian-qiao-sun.

III

Special Sessions

Women at NEO

Chairs:

- **Dr. Adriana Lara**
- **Dr. Marcela Quiroz**


This special session W-NEO is a way to encourage the presence of women in Science, in particular, in numerical optimization and computing. The goal is to gather young and consolidated female researchers and practitioners to share experiences and paths for possible joint work. W-NEO 2020 presents talks about recent research advances reached by women. Additionally, this space will be an opportunity to discuss realities, problems, and possible solutions about the gender gap in our community.

We will also hold space for networking to inspire, engage, and advise students who are currently working—or planning to work–on NEO areas. We will hold some brief talks and a meeting.

Topics

- Optimization
- Energy
- Numerical applications
- Evolutionary computing

Circuits and Systems for AI

Chair: Dr. Luis Gerardo de la Fraga

In this session will be analyzed and proposed new hardware development to solve Artificial Intelligent tasks. We are very interested how to optimize this new developments in the area of Data Science and AI of things (AIoT).

Topics

- Devices, circuits, and systems in the new era of AI
- Analog/digital devices, circuits, and systems for AI
- Modeling, simulation, optimization, and design automation tools for AI
- Embedded/hybrid hardware and computing for AI
- Speech/video signal processing circuits and systems for AI
- AI circuits and systems for security and cryptography applications
- AI circuits and systems for biomedical, autonomous, and human–machine systems
- Emerging applications of AI

Discrete Optimization

Chair: Dr. Marcela Quiroz Castellanos

Applications of discrete optimization problems arise in engineering, science, economics, and everyday life. It is common to find in many real-world linear, as well as nonlinear programming, that all, or a fraction of variables are restricted to be integer, yielding integer or mixed integer-discrete-continuous problems. Many of these problems are computationally intractable. The approaches that are addressing these problems include: traditional optimization techniques, efficient preprocessing schemes, decomposition techniques, fast heuristics, metaheuristics and hybrid methods. This special session serves as a platform for researchers from all over the world to present and discuss recent advances and perspectives in the mathematical, computational and applied aspects of all areas of integer programming, combinatorial optimization and mixed integer-discrete-continuous optimization.

Topics

- Single and multi-objective optimzation
- Deterministic approaches
- Algorithms
- Randomized algorithms
- Heuristics
- Metaheuristics
- Simulation
- Stochastic programming
- Real-world applications

Wind Energy Resources

Chair: Dr. Rafael Campos Amezcua

The increasing demand for electrical energy, as well as the adverse effects of the indiscriminate use of fossil fuels, encourage the search for new sources of energy that are more environmentally friendly, safe, and economically feasible. Wind energy is the most widely used renewable energy source to produce electricity. Wind turbines are the devices that are used to transform the kinetic energy of the wind into electrical power. Although it is a mature technology, with more than 100 years of existence, there are still various challenges that require study and research, from the early stages of a wind power project, such as the evaluation of the wind resource, through the design of wind turbines and even systems integration.

Topics

- Wind power assessment
- Wind speed forecasting
- Computational Fluid Dynamics
- Wind turbines

Optimization in Industry

Chair: Dr. Oliver Cuate

Optimization is present in everyday life, not only in our daily problems but also in the most relevant aspects of the industry. Such applications are increasingly demanding, which has led to the emergence of complex optimization problems that, as a consequence, require more sophisticated solution processes. Currently, it is common to be faced with large-scale optimization problems (i.e., where the number of variables is high), many objective optimization problems (i.e., problems where more than four goals have to be optimized concurrently) and instances with complex constraints (such as equality constraints). Besides, the decision-making process is also an important aspect that must be taken into account in real-world problems. This special session serves as a platform for researchers from all over the world to present and discuss recent advances in optimization applied to complex problems, which are still a challenge for both academia and industry. The aim is the presentation of new challenges by the industry and the proposal of new solution methods by the researchers.

Topics

- Single and multi-objective optimzation
- Many objective optimization
- Large scale optimization
- Multi-level optimization
- Decision-making process
- Metaheuristics
- Constraint handling
- Modeling and simulation
- Real-world applications

Photovoltaic and Thermal Solar Energy

Chair: Dr. Iván Salgado Tránsito

The energy transition towards a more sustainable energy system requires having power generation systems that meet the following characteristics: reliability, low cost, flexible to meet a variable demand and friendly to the environment. The intermittency of renewable energies as solar and wind energy makes it difficult. Therefore, to compensate the variability of solar power systems (photovoltaic and solar thermal); it is necessary to have several distributed generation energy and storage systems. Thus diversification of the energy matrix makes essential to develop mathematical models that optimize the production of solar systems to maximize the production, profitability, reliability and dispatchability while minimize the cost production and the emissions of GHG. The goal of this special session is to begin an important discussion between those working on developing new optimization strategies in PV and Solar thermal Energy systems.

Topics

- Optimization of PV and solar thermal systems
- Applications of Machine Learning in Solar Energy applications
- Position papers on the importance of Optimization and Learning in this area

Set Oriented Numerics

Chair: Dr. Oliver Schütze

Set oriented methods have proven to be very efficient in the numerical treatment of various classes of global optimization problems in academy and industry and are widely used in many fields, such as Engineering and Finance. This special session serves as a platform for researchers from all over the world to present and discuss recent advances in set oriented numerical methods in particular in the context of optimization. Methods of this kind iterate (or evolve) entire sets instead of considering point-wise iterative methods and are thus in particular advantageous if a thorough investigation of the entire domain is required and/or the solution set is not given by a singleton.

Topics

- Cell mapping techniques
- Subdivision techniques
- Continuation methods
- Swarm-like strategies
- Methods for all kinds of optimization problems, including scalar, multi-objective, bi-level, and dynamic optimization problems
- Applications to real-world problems

IV Tutorials

Opportunities for Students in AI at UV

Instructor: Dr. Marcela Quiroz

Nowadays everyone talks about Artificial Intelligence (AI), we are told that the technologies we use every day include AI and that large industries will automate their processes through AI. Analysts estimate that millions of jobs will be affected by AI over the next few decades. What does this mean for the country? Are Mexican companies prepared to face this challenge? Are students aware of what this new technological revolution implies and how can they be part of it? In this talk we will see what Artificial Intelligence is, its history and some of the recent advances. In particular, we will talk about how AI can be applied in almost every field, from medicine to the arts. We will also present the efforts carried out at the Artificial Intelligence Research Center of the Universidad Veracruzana (CIIA-UV) to influence the development of this area.

NEO 2020
8th International Workshop on
Numerical and Evolutionary Optimization
November 18 and 19, 2020

Bilevel Optimization Without Tears

Instructors:

- **Jesús Adolfo Mejía de Dios**
- **Dr. Efrén Mezura Montes**

This tutorial offers a gentle introduction to bilevel optimization (BO) by using practical examples but highlighting the main differences between BO and other traditional optimization tasks such as global optimization, constrained optimization and multi-, many-objective optimization. A bird's-eye view describing mathematical-programming-based and also metaheuristic-based approaches is considered as well. Finally, an online resource will be provided to the attendees so they can write and solve their own BO problem (https://bi-level.org/tutorial/).

Graduate Studies in CS at Cinvestav-IPN

Instructor: Dr. Guillermo Morales Luna

The CS graduate programs, PhD and MSc, in Cinvestav-IPN were established in the 80's within the Electrical Engineering Department and from 2006 the certificates awarded by our Department are exclusive for Computer Science. Our main subjects are Heuristics Computing, Optimization, Software Engineering, Collaborative Computing, Cryptology and Mathematical Foundations. Some scientists of our Faculty have been recognised by prestigious scientific prizes. Our studies and researches are done in Spanish and English. Our graduate alumni have had notorious impact in both academia and industry. Our students get scholarships from the Mexican Conacyt, independently of their citizenship. We will describe the studies offers and opportunities in our CS Department.

NEO 2020
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November 18 and 19, 2020

Optimization using Python

Instructor: Dr. Luis Gerardo de la Fraga

In this tutorial we are going to learn how to use a Genetic Algorithm and Differencial Evolution to solve very simple academic problems. A little introduction to Python programming language will be also given. Python is recommended to code the heuristic but not to code to problem in hand, because the cost part is the evaluation of the objective function.

Part of the used code is available here:
https://delta.cs.cinvestav.mx/ fraga/OptCode.tar.gz

VHDL by MOEA

Instructor: Dr. Yazmín Maldonado Robles

In the state of the art there are around 20 tools for HLS (High Level Synthesis) in FPGAs, some for academic purposes (free software), although most need a license that is not free. Of all these tools, only 6 are for academic purposes and none of these are focused on multi-objective optimization that can be done in HLS. VHDL by MOEA is a free access tool that allows the user to give a behavior description in C language as input, which may contain logical and arithmetic expressions; shows the user the DFG that represents the semantics of the behavior description inserted as input; allows the user to select the MOEA (SPEA2, NSGA-II, NSGA-III) and its parameters for optimization; displays the target space while optimization is in progress, with the goal that the user visualizes the minimization of the target, delay, area, and power functions; it allows the user to select which solution they prefer, in addition to being able to select the any solution in the Pareto set. As output, it provides the user with the optimized VHDL code along with that a few basic schedules. This code can be downloaded and implemented in an FPGA using Xilinx Vivado or Intel Quartus.

Based on our review of the state-of-the-art, we can say that “VHDL by MOEA” is unique in its kind, since up to now there is no tool that converts C code to VHDL and optimizes 3 objective functions using a multiobjective approach. Furthermore, it allows the user to observe the evolutionary process in real time as it proceeds in objective space.

With VHDL by MOEA we have a specialized tool that allows inexperienced users in the area of artificial intelligence, multi-objective evolutionary algorithms and embedded systems - FPGAs, to use them without worrying about learning digital design or FPGA programming, none of which are trivial tasks. The tool is freely accessible and can be found online at http://201.174.122.25/vhdlbymoea/

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November 18 and 19, 2020

Wind Data Analysis and Data Imputation

Instructors:

- **Claudia Sánchez**
- **Dr. Mario Graff**

This tutorial presents how to use matplotlib, a python library, for exploring, visualizing, and understanding a wind data base. Based on the daily registers of wind speed and direction, we are going to analyze the wind behavior by months or hours. Besides, because some of the sensors could fail, for the imputation of missing data we are going to use classical interpolation techniques and machine learning tools.

V

Contributed Talks

List of Talks

November 18

- Lu Jiang and Furui Xiong. *Numerical Simulation and Optimization on Sealing Performance of the Spring Energized C-ring in Reactor Pressure Vessel*
- Yuanlin Li, Li Cheng, and Tao Bai. *HySim: Co-simulation Platform and its Engineering Application in Multidisciplinary Optimization Design*
- Perla Rubi Castañeda, Esteban Tlelo Cuautle and Luis Gerardo De la Fraga. *Single-objective Optimization of a CMOS VCO Considering Monte Carlo Simulation*
- Luis Gerardo De La Fraga. *Data Types in a Supervised Learning Application*
- Bennet Gebken and Sebastian Peitz. *An efficient descent method for locally Lipschitz multiobjective optimization problems*
- Leonardo Guerrero, Diana Gamboa and Rosana Gutiérrez. *Mathematical Analysis for a Nonlinear Type 1 Diabetes Mellitus Model*
- Salvador Botello-Aceves, S. Ivvan Valdez and Arturo Hernández Aguirre. *Difficulties of a local transformation for multi-objective optimization problems: Is it worth it?*
- Lourdes Uribe, Johan M Bogoya, Andrés Vargas, Adriana Lara, Guenter Rudolph and Oliver Schüetze. *A Set Based Newton Method in the Δp Sense*
- Lucía J. Hernández-González, Juan Frausto Solís, J. Javier González Barbosa, José Enrique Olvera Vázquez, Juan Paulo Sánchez-Hernández and Edgar Roman-Rangel. *Forecasts for confirmed covid cases using CNN, ARIMA and Exponential Smoothing*
- Youness El Hamzaoui and Juan Antonio Álvarez Arellano. *Optimization of Operating Conditions for Hydraulic Concrete Structures using an Artificial Neural Networks Inverse*
- Guadalupe Castilla Valdez, Juan Frausto Solís, Moisés Israel Herrera Ramos, J. Javier González Barbosa and Leonor Hernández Ramírez. *A Neuroevolutionary Forecasting Algorithm for Time Series with Genetic and Simulated Annealing Algorithms*
- Martín Alejandro Valencia Ponce, Esteban Tlelo Cuautle and Luis Gerardo De la Fraga. *Multi-objective optimization of a CMOS OTA's linearity for chaotic oscillators*
- Natan Vilchis-Tavera and Adriana Lara. *A Genetic Algorithm to Effectively Design Musical Counterpoints*
- Josué Gómez, América Morales and Chidentree Treesatayapun. *Comparison between classical model and data driven model of the first order kinematic control for a redundant robot*
- Salvador Lobato and Juan Gabriel Ruiz. *Optimizing the energy for an industrial robotic arm manipulator using Particle Swarm Optimization algorithm*
- Rogelio Valdez and Yazmin Maldonado. *FPGAS as efficient accelerators for the implementation of heterogeneous computing*

- David Laredo Razo. *Optimizing the Operating Personnel Costs (OPC) at Bosch's Toluca plant*
- Carlos I. Hernández Castellanos, Sina Ober-Blöbaum and Sebastian Peitz. *Explicit Multi-objective Model Predictive Control for Nonlinear Systems Under Uncertainty*
- Youness El Hamzaoui, Juan Antonio Álvarez Arellano and J.A Rodríguez. *Modeling of a Steam Turbine through Neural Network Training using Genetic Algorithms*
- Víctor Ramos Fon Bon, Roberto Horacio Albores Arzate, Manuel De Jesús Palacios Gallegos, Edalí Camacho Ruiz, Cristina Blanco González and Aremi Olaya Virrueta Gordillo. *Generation of virtual maps of the solar resource in the State of Chiapas, México*
- Fernando Moreno Gómez and Adriana Lara. *Optimizing Roof-gardens Location for Mexico City Air Quality Improvement*
- Esmeralda López-Garza, René Domínguez-Cruz and Iván Salgado Tránsito. *Optimization management for electric power grids based on a linear model*
- Héctor J. Fraire Huacuja, Daniela López-García, Laura Cruz Reyes, Nelson Rangel Valdez, Claudia G. Gómez Santillán, María Lucila Morales Rodríguez and Fausto Antonio Balderas-Jaramillo. *Optimization of the Project Selection Multi-objective Problem with Type Interval Fuzzy Parameters*
- Leonor Hernández Ramírez, Juan Frausto Solís, Guadalupe Castilla Valdez, J. Javier González Barbosa and Juan Paulo Sánchez-Hernández. *Chaotic Multi-Objective Simulated Annealing and Threshold Accepting for Job Shop Scheduling Problem*
- Octavio Ramos-Figueroa and Marcela Quiroz-Castellanos. *An Experimental Study of Grouping Mutation Operators for the Unrelated Parallel-Machine Scheduling Problem*

November 19

- Katharina Bieker, Bennet Gebken and Sebastian Peitz. *On the treatment of optimization problems with L1 penalty terms via multiobjective continuation*
- Manuel Berkemeier and Sebastian Peitz. *Derivative-Free Multiobjective Trust Region Descent Method Using Radial Basis Function Surrogate Models*
- Carlos Hernández and Oliver Schüetze. *Archiving Strategies for Multi-objective Evolutionary Algorithms*
- Antonin Ponsich, Bruno Domenech, Laia Ferrer-Martí, Alberto García-Villoria and Rafael Pastor. *Comparison of archive pruning strategies for the multi-objective optimization of stand-alone electrification systems*
- Josué Jordi Zavala-Morales, Erasmo Cadenas Calderón and Rafael Campos. *Optimal design of a wind turbine blade based on its mass, in the domain of stress and tip speed ratio*
- Alma Rosa Méndez Gordillo, Rafael Campos Amezcua and Erasmo Cadenas Calderón. *Existence of multifractality in wind speed time series*
- Julio Cesar Solís Sánchez, Manuel De Jesús Palacios Gallegos, Roberto Horacio Albores Arzate, Cristina Blanco González, Edalí Camacho Ruiz, Víctor Ramos Fon Bon, Aremi Olaya Virrueta Gordillo and Josué Chanona Soto. *Development of a methodology to optimize low-power wind energy harvesting*
- Marcos Hernández Ortega, Rafael Campos Amezcua, Roberto Gómez Martínez, Hugo Abundis Fong, Luis Gerardo Trujillo Franco and Luis Manuel Palacios Pineda. *Numerical and experimental analysis of the near wake behind a small wind turbine rotor*
- Mercedes Pérez-Villafuerte, Laura Cruz Reyes, Nelson Rangel Valdez, Claudia G. Gómez Santillan and Héctor J. Fraire Huacuja. *Effect of the profile of the decision maker in the search for solutions in the decision-making process*
- Teodoro Macias-Escobar, Laura Cruz Reyes, Cesar Medina-Trejo, Claudia G. Gómez Santillán, Nelson Rangel Valdez and Héctor J. Fraire Huacuja. *Interactive recommendation system for the multiobjective project portfolio problem based on the characterization of cognitive tasks*
- Claudia Orquídea López Soto, Emiliano Traversi and David Chaffrey Moreno Fernández. *Core problem based heuristics for the probabilistic revenue management problem*
- Joel Chacón Castillo and Carlos Segura González. *A Variant of Differential Evolution with Enhanced Diversity Maintenance*
- Guadalupe Carmona Arroyo, Marcela Quiroz Castellanos and Efrén Mezura Montes. *Variable Decomposition for Large-scale Constrained Optimization Problems Using a Grouping Genetic Algorithm*
- José Yair Guzmán-Gaspar, Efrén Mezura-Montes and Saúl Domínguez-Isidro. *Differential Evolution in Robust Optimization Over Time: Survival Time Approach*
- Juan Gabriel Ruiz Ruiz and Salvador Enrique Lobato Larios. *Optimization of the Design of a Website Using an Interactive Genetic Algorithm*
- Xochitl S. Delgado Hernández, María Lucila Morales Rodríguez and Nelson Rangel Valdez. *Optimization of Phrase Selection for a Conversational Virtual Agent through Speech Acts and Outranking Methods*

- Juan Frausto Solís, J. Javier González Barbosa, Guadalupe Castilla Valdez, José Luis Purata Aldaz, Diego Soto Monterrubio and Leonor Hernández Ramírez. *GenPo Sharpe: Stock Selection for Investing Portfolio using a Genetic Algorithm with Sharpe Ratio Applied to Mexican Stock Exchange*
- Jessica Elena González San Martín, Laura Cruz Reyes, Bernabé Dorronsoro, Marcela Quiroz Castellanos, Nelson Rangel Valdez, Claudia G. Gómez Santillán and Héctor J. Fraire Huacuja. *The Bin Packing Optimization Problem: Algorithm Analysis and Open Problems*

Numerical simulation and optimization on sealing performance of the spring energized C-ring in a reactor pressure vessel

Lu Jiang 1[a], Furui Xiong 2[a]

[a]National Key Laboratory of Science and Technology on Reactor System Design Technology
Chengdu City, Sichuan Province, China
npic_lujiang@163.com

Spring energized C-ring is popularly used for the bolted flange connection in a reactor pressure vessel (RPV) seal based on its exceptional resilience and high pressure capability. To ensure effective sealing, professional analysis and design programs are essential to examine its complex mechanical behavior and sealing characteristics under various loading conditions. In this communication, a refined three dimensional finite element analysis model comprised of the outer jacket, middle lining and inner spring is proposed for C-ring. To validate the model correctness, a numerical simulation on compression and recovery property is performed. Deformation, stress distribution, and sealing-behavior curve, are compared with test data. In addition, plastic deformation accumulation of C-ring under RPV cyclical loadings is studied to evaluate fatigue failure. Further, using ANSYS APDL, sensitivity analysis is carried out to explore the design concept of C-ring structural parameters such as the spring wire diameter, middle lining, and outer jacket thicknesses. Finally, based on the ISIGHT platform, optimization process on sealing and fatigue performance of C-ring is demonstrated.
Keywords: C-ring, compression and recovery, cyclical loading, optimization

HySim co-simulation platform and its engineering application in multidisciplinary optimization design

Yuanlin Li, Li Cheng and Tao Bai

PERA CD Technology
Co.Ltd, Unit 2602-2607, Tower 2, Chengdu IFS, Chengdu 610021,China

In engineering design, digital design and simulation are more and more indispensable. The finalization of a complex product often requires close cooperation of various professions. Therefore, in the process of product design and simulation, multi-disciplinary and multi-disciplinary coupling simulation analysis is often needed. HySim, a co-simulation platform developed by PEAR CD Technology Co.Ltd. HySim has software package, parameter correlation, parameter driving and other functional modules, which can integrate multidisciplinary simulation analysis process into a unified framework. Meanwhile, by encapsulating multidisciplinary optimization algorithm, HySim can help engineers realize intelligent optimization design. HySim has been successfully applied in several projects and plays an important role in the field of multidisciplinary design. Meanwhile, this paper introduces an improved Taguchi optimization algorithm for heat dissipation design of circuit board. The traditional Taguchi optimization algorithm has no randomness, so it is easy to fall into a local optimal solution. Therefore, we added randomness to Taguchi's optimization algorithm to improve its adaptability to complex problems. We have successfully applied this optimization algorithm in the circuit board design optimization project, and the effect is remarkable.

Keywords: HySim, co-simulation, multidisciplinary optimization

Single-objective Optimization of a CMOS VCO Considering Monte Carlo Simulation

Perla Rubi Castañeda-Aviña[a], **Esteban Tlelo-Cuautle**[a], **Luis Gerardo de la Fraga**[b]

[a]Department of Electronics, INAOE
Luis Enrique Erro 1, 72840 Puebla, México
perlacastaneda@inaoep.mx, etlelo@inaoep.mx

[b]Computer Science Department, Cinvestav
Av. IPN 2508, 07360 Mexico City, México
fraga@cs.cinvestav.mx

The integrated circuit's optimization requires to take into account a number of considerations and trade offs that are specific to each circuit, meaning that certain circuits are suitable for the application of single and multi objective algorithms [2]. Herein a single-objective optimization approach is employed to maximize the oscillation frequency of a CMOS four stage voltage-controlled oscillator (VCO) in a ring structure by using differential evolution (DE) algorithm where the design variables are the control voltage as well as the transistor's widths and lengths. The VCO's delay cell is implemented with differential pairs [1], meaning that the oscillation frequency is heavily dependent of the cell's delay time and that therefore is necessary to consider the implications of this relation over the optimization.

The optimization occurs by applying the DE algorithm to minimize an objective function which in turn is defined primarily as a function of both the period of the output signal and the summation of the constraints. The established constraints are related to guarantee an appropriate gain among 1 to 5 dB and to assure each transistor to be operating in the desired region setting to 0 the satisfied constraints and to 1 the non satisfied ones. This process implies to obtain data from SPICE's output file throughout the simulation process.

Within the feasible VCO designs resulting from the DE algorithm there are a set of solutions that are characterized to have large ranges of both frequency tunning range and control voltage. Furthermore, the robustness of the optimized design is tested through Monte Carlo simulations and a statistical analysis of this results is carried out.

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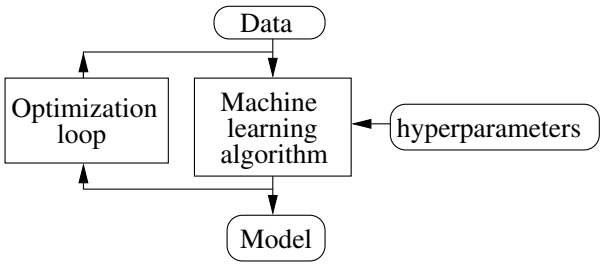
Data Types in a Supervised Learning Application

Luis Gerardo de la Fraga

Computer Science Department, Cinvestav
Av. IPN 2508, 07360 Mexico City, México
fraga@cs.cinvestav.mx

In the diagram shows the tasks for training a model using a Supervised Learning algorithm: input data is necessary, it is split in training and test parts, a machine learning algorithm is applied to solve a regression or classification task, and an output model is generated. If one or two hyperparameters are used, then an optimization loop by a search grid is used. With more parameters could be necessary to integrate an evolutionary algorithm to perform the optimization task. FPGAs and ASICs have been applied to speed up the training and obtain the model and also to execute it. Research is necessary to investigate the data types used in this kind of task. 16 bits types: floating point of 16 bits, 16 bits integers, or brain floating points, could be used [1, 2]. Possibly, a mixture of types with 32 bits types can be used also. The use of types with lesser bits also allows a smaller model storage. The use of custom types is also possible for a very specific application. How an evolutionary algorithm performs using these short types must be also investigated. The viability to direct our future search guidelines to this topic will be discussed. Preliminary results of differential evolution performing with integer arithmetic at different number of bits in the fracctional part will be show.



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An efficient descent method for locally Lipschitz multiobjective optimization problems

Bennet Gebken[a], Sebastian Peitz[a]

[a]Institute of Mathematics
Paderborn University
Warburger Str. 100, 33098 Paderborn
bgebken@math.upb.de, speitz@math.upb.de

In this talk, we propose an efficient descent method for unconstrained, nonsmooth multiobjective optimization problems (MOPs) with locally Lipschitz continuous objective functions. In contrast to most solution methods for nonsmooth MOPs, which are based on evolutionary computation, our method is deterministic and provably convergent to points which satisfy a necessary condition for Pareto optimality.
Typically, the difficulty of nonsmooth optimization comes from the fact that gradients can not be used to describe the local behavior of the objective functions. To overcome this difficulty, the so-called *Clarke subdifferential* from nonsmooth analysis can be used. In 2015, based on this subdifferential, Attouch et al. proposed a (theoretical) descent direction for nonsmooth MOPs. Since subdifferentials are difficult to compute in practice, they have to be approximated. To this end, we combine the results of Attouch with an efficient way of approximating the Clarke subdifferential, which was proposed by Mahdavi-Amiri and Yousefpour in 2012, to obtain a descent direction which can be efficiently computed in practice. Adding an Armijo-like line search results in a convergent descent method for nonsmooth MOPs. Using a set of test problems, a comparison with the *multiobjective proximal bundle method* by Mäkelä (2014) shows that our method is competitive in terms of efficiency while being easier to implement. Finally, our method can be combined with a *subdivision algorithm* to compute entire Pareto sets of nonsmooth MOPs.

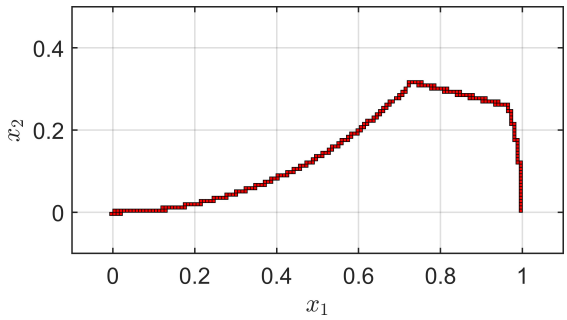

Figure 1: Pareto set of a nonsmooth MOP (Problem (15,16) from [3]).

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Mathematical Analysis for a Nonlinear Type 1 Diabetes Mellitus Model

Leonardo Guerrero González[a], Diana Gamboa Loaiza[b],Rosana Gutiérrez Montoya[c]

[a]Tecnológico Nacional de México, Instituto Tecnológico de Tijuana Blvd. Alberto Limón Padilla s/n, Mesa de Otay, 22454 Tijuana, B.C., Mexico; leonardo.guerrero18@tectijuana.edu.mx

[b]Tecnológico Nacional de México, Instituto Tecnológico de Tijuana Blvd. Alberto Limón Padilla s/n, Mesa de Otay, 22454 Tijuana, B.C., Mexico; diana.gamboa@tectijuana.edu.mx

[c]Tecnológico Nacional de México, Instituto Tecnológico de Tijuana Blvd. Alberto Limón Padilla s/n, Mesa de Otay, 22454 Tijuana, B.C., Mexico; rosana.gutierrez@tectijuana.edu.mx

In type 1 diabetes mellitus (DM1) cytotoxic T-lymphocytes seek out and destroy beta cells which produces an absolute lack of insulin. The destruction of beta cells is the product of the person's own immune system due to an unknow condition. Over the past few years, there have been multiple papers that focus on analyzing the dynamics of DM1 in a mathematical sense. It has been shown that naive T cells interact with fragments of apoptotic beta cells, "peptide", and when activated they proliferate to produce effector and memory T cells which lead to a positive feedback on the amount of peptide produced, and hence on further activation of T cells and destruction of beta cells[1]. This paper studies the global dynamics of DM1 reported by Mahaffy et al. in 2007. This model describes the interaction of activated T cells, effector T cells, memory T cells, beta cells and peptide level, also, the model is reduced assuming a quasi-steady state (QSS) assumption on the peptide. Both the complete model and the reduced QSS model are analyzed. By applying the Localization of Compact Invariant Sets method, we provide a bounded positive invariant domain based on the maximum value of each of the variables of the models, numerical simulations are performed. Furthermore, we analyze this models in a closed-loop using Lyapunov's theory of stability in order to determine the viability of implementing control inputs which may represent a treatment and their biological implications.

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Difficulties of a local transformation for multi-objective optimization problems: Does it worth it?

Salvador Botello-Aceves[a], **S. Ivvan Valdez**[b], **Arturo Hernandez-Aguirre**[a]

[a]Computer Science Department
Centro de Investigación en Matemáticas A.C.
Jalisco S/N, Col. Valenciana, Guanajuato, Gto, México
{salvador.botello,artha}@cimat.mx

Centro de Investigación en Ciencias de Información Geoespacial
Contoy 137 Esq. Chemax, Col. Lomas de Padierna, Querétaro, Qro, Mexico.
svaldez@centrogeo.edu.mx

The IDM method transforms improvement directions in the objective space to search directions in the variable space in order to independently steer the search of each solution in the solution set towards promising regions. The most relevant issue of the Jacobian-based transformation procedure is its ill conditioning, that provokes numerical instability of the direction transformation as the solution front approximates to the Pareto front, this issue greatly impacts the displacement of the solution set. This work revisits three Jacobian based transformation and three gradient-free transformations, presented in the literature, to alleviate this problem. Based on experimental results of the inverse condition number of each transformation and the error of the evaluation of the displaced solution, we discuss the advantages, disadvantages and their application niche.

Since the Improvement Direction Mapping method (IDM) applies improvement directions in the objective space in order to predict a favorable search direction in the variable space. Therefore, for a given solution $\mathbf{x}$ in the solution front, the mathematical expression of the improvement direction is given as:

$$\mathbf{p} = \{\mathbf{p} \in \mathbb{R}^m | \mathbf{x} + \mathbf{d} \triangleleft \mathbf{x}\} \tag{1}$$

where $\mathbf{p} \in \mathbb{R}^m$ is the improvement direction in the objective space and $\mathbf{d} \in \mathbb{R}^n$ is the search direction in the variable space, given by a transformation, $\mathbf{H}(\mathbf{x}, \mathbf{p})$, in the objective space to the variable space at $\mathbf{x}$. The $\triangleleft$ operator describes that the displaced solution $\mathbf{x} + \mathbf{d}$ is "better" than $\mathbf{x}$. In general, the IDM method seeks to improve the solutions by local modifications such that, the displaced solution dominates the current solution.

By the means of the total differentiation, a perturbation on the objective space is liken to the variable space by a linear transformation via the Jacobian matrix $\mathbf{J}$. Since $m << n$, the pseudo-inverse formulation of the linear transformation is needed, given as:

$$\mathbf{d} = \mathbf{J}^{\dagger}\mathbf{p} \tag{2}$$

where $\mathbf{J}^{\dagger}$ is the pseudo-inverse of the Jacobian matrix. Another way to measure the improvement of a displaced solution is through a scalarization function, $g(\mathbf{f}(\mathbf{x})|\lambda)$, which qualifies the performance of the individual based on to the proximity to a reference point $\mathbf{z}$ and the reference vector λ. By defining the search direction $\mathbf{d}$ as the first derivative of the scalarization function with respect to the decision variables, we have:

$$\mathbf{d} = \mathbf{J}^{\intercal}\mathbf{p} \tag{3}$$

where the improvement direction is given as the first derivative of the scalarization function with respect the objectives, $\mathbf{p} = \nabla_{\mathbf{f}} g(\mathbf{f}(\mathbf{x})|\lambda)$, and $\mathbf{J}^{\intercal}$ is the transpose of the Jacobian matrix.

Such Jacobian-based transformation have shown numerical instability as the solution set approximates the Pareto front. The behaviour of the Jacobian matrix is presented in this work by sampling a bi-variable space and evaluated a well-known set of benchmarks bi-objective problem. The relation between a pair of objective gradients and their conflict is discussed.
In order to alleviate this issue, a normalized pseudo-inverse operator is proposed in order to remedy the misadjusting scale of the search direction generated by a badly conditioned transformation. This normalized pseudo-inverse does not take into account the singular values of the SVD decomposition, used to computed the pseudo-inverse.
Given that it is sought a representation of the Pareto front by a finite set of solutions, it is possible to use information from a set $\mathcal{N}$ of neighboring solutions to approximate the Jacobian and subsequently is used to transform the improvement direction. The first approach promotes the use of finite differences, which approximate the Jacobian at a point $\mathbf{x}$ as:

$$J_{i,j} = \sum_{k=i}^{|\mathcal{N}|} \frac{1}{|\mathcal{N}|} \frac{f_i(\mathbf{x}_k) - f_i(\mathbf{x})}{||\mathbf{x}_k - \mathbf{x}||} x_k^{(j)} - x^{(j)} \tag{4}$$

where $\mathbf{x}_k \in \mathcal{N}$ is the k-th neighboring solution of $\mathbf{x}$, $x^{(j)}$ is the j-th decision variable, $J_{i,j}$ is the i-th and j-th components of the Jacobian matrix. The second approach computes for each objective a local quadratic regression. Each row of the Jacobian is given as the first derivative of the quadratic regression, as:

$$\mathbf{J}_{i,\cdot} = \mathbf{A}^{(i)}\mathbf{x} + \mathbf{b}^{(i)} \tag{5}$$

where $\mathbf{J}_{i,\cdot}$ is the ith row of the Jacobian matrix, $\mathbf{A} \in \mathbb{R}^{n \times n}$ and $\mathbf{b}\mathbb{R}^n$ are the quadratic and linear coefficients of the i-th objective, respectively. The last approach uses an iterative formulation to compute a transformation tensor, based on the Broyden method, to transform the improvement direction. This approach uses the last step transformation tensor $\mathbf{H}_k$ in order to compute the next transformation tensor $\mathbf{H}_{k+1}$, once the solution is displaced. By mean of the projection of the evaluation of the displaced solution to the improvement vector, the transformation tensor is given as:

$$\mathbf{H}_{k+1} = \mathbf{H}_k \left(\frac{(\mathbf{p} - \mathbf{y})}{\mathbf{p}^\intercal \mathbf{H}_k^\intercal \mathbf{H}_k \mathbf{y}} \mathbf{y}^\intercal + \mathbf{I} \right) \tag{6}$$

where $\mathbf{y} = \mathbf{f}(\mathbf{x}_k) - \mathbf{f}(\mathbf{x}_{k+1})$ is a difference vector in the objective space, and $\mathbf{I} \in \mathbb{R}^{n \times m}$ is the identity matrix. In this work, the inverse condition number and the internal product between the evaluation of the displaced solution and the improvement direction are analysed by a sampling of the multivariate variable space of a set of well-known unconstrained multi-objective problems. Such experiments will let to the description of the behaviour of each transformation. Advantages and disadvantages are discussed.

A Set Based Newton Method in the Δ_p Sense

Lourdes Uribe[a], **Johan M Bogoya** [b], **Andrés Vargas** [b], **Adriana Lara**[a], **Günter Rudolph**[c], and **Oliver Schütze**[c]

[a]Escuela Superior de Física y Matemáticas
Instituto Politécnico Nacional
Av. Instituto Politécnico Nacional. Building 9, C. P. 07738. Mexico City, Mexico.
lourdesur@esfm.ipn.mx, adriana@esfm.ipn.mx

[b]Mathematics Department
Pontificia Universidad Javeriana
Cra. 7 N. 40-62. 111321 Bogotá, Colombia.
jbogoya@javeriana.edu.co, a.vargasd@javeriana.edu.co

[c]Computer Science Department
Technical University of Dortmund
Otto-Hahn-Str 14. 44227, Dortmund, Germany.
Guenter.Rudolph@tu-dortmund.de

[d] Computer Science Department
Cinvestav-IPN
Mexico City, Mexico
schuetze@cs.cinvestav.mx

In literature, one can find several methods for the treatment of MOPs; for example, mathematical programming techniques such as scalarization methods. There are also set oriented methods that are capable of obtaining the entire solution set globally. For instance, subdivision techniques or multi-objective evolutionary algorithms (MOEAs). Several MOEAs have been designed incorporating different performance indicators, like hypervolume and Δ_p. Since each of these indicators assigns a real number to any population (or any other subset of the domain of the problem), they also induce several scalar optimization problems defined on the MOEA populations. In this work, we present a set based Newton method in the Δ_p sense. Theoretical results will show that one can expect local quadratic convergence toward the optimal population, which will be underlined by some numerical results. Since we required an approximation of the entire Pareto front of the given MOPs we show results of two different ways of computing it. The first one via the shifted CHIM and the second one via a bootstrapping method.

Forecasts for confirmed covid cases using CNN, ARIMA and Exponential Smoothing

Lucía J. Hernández-González [1],**Juan Frausto-Solís** [1,*], **Juan J. González-Barbosa** [1]
José Enrique Olvera Vazquez [1], **Juan Paulo Sánchez-Hernández** [2]
Edgar Roman-Rangel [3]

[1]División de Estudios de Posgrado e Investigación
Tecnológico Nacional de México/Instituto Tecnológico de Ciudad Madero
Av. 1o. de Mayo esq. Sor Juana Inés de la Cruz s/n
Col. Los Mangos C.P.89440 Cd. Madero Tamaulipas, MÃ©xico
luciajaneth.hernandez@gmail.com (L.J.H.-G.), juan.frausto@gmail.com (J.F.-S.)
jjgonzalezbarbosa@hotmail.com (J.J.G.-B.), g12071265@itcm.edu.mx (J.E.O.V.)

[2]Dirección de Informática, Electrónica y Telecomunicaciones
Universidad Politécnica del Estado de Morelos
Boulevard Cuauhnáhuac 566, Col. Lomas del Texcal, Jiutepec, Morelos. C.P.62550
juan.paulosh@upemor.edu.mx

[3]Departamento Académico de Sistemas Inteligentes
Instituto Tecnológico Autónomo de México
01080 Ciudad de México
edgar.roman@itam.mx

[*]correspondence: juan.frausto@gmail.com

Abstract
The health contingency experienced around the world by the COVID-19 virus from December 2019 to September 2020 has left 26,398,466 infected people and 870,000 deaths. Unfortunately, these figures have been increasing without having a statistical forecast of the number of new cases. Using time series which characterize the behavior of the number of infected people with machine learning and deep learning techniques can offer a forecast that allows us to understand the growth of new cases of contagion in a given country. The objective of this work is to present a new methodology that incorporates deep learning techniques such as the Convolutional Neural Network (CNN) to forecast new confirmed cases of COVID-19 for the countries of Mexico and the United States of America. An experimentation was carried out to tune the CNN parameter settings. The forecasts were adjusted with ARIMA and Exponential Smoothing. The results show forecasts close to the real values.

Optimization of Operating Conditions for Hydraulic Concrete Structures using an Artificial Neural Network Inverse

Y. El Hamzaoui and J. A. Alvarez Arellano

The optimization of the compressive strength of hydraulic concrete structures using artificial intelligence. The aim of this paper is to develop an integrated approach using artificial neural network inverse (ANNi) coupling with a Nelder Mead optimization method to predict compressive strength. The proposed method ANNi is a new tool which inverts the artificial neural network (ANN). First, It is necessary to build the artificial neural network (ANN) that simulates the output parameter of compressive strength. ANN's model is constituted of a feedforward network with one hidden layer to calculate the output of the process when input parameters are well known, then inverting ANN. We could use the ANNi as a tool to estimate the optimal unknown parameter required (strain stress). Very low percentage of error and short computing time are precise and eficient, make this methodology (ANNi) attractive to be applied for automatic modelling and control on line of the compressive strength in this domain and constitutes a very promising framework for finding things out of "good solutions".

Keywords: Inverse neural networks, optimal parameters, optimization, hydraulic concrete structures, compressive strength

A Neuroevolutionary Forecasting Algorithm for Time Series with Genetic and Simulated Annealing Algorithms

Guadalupe Castilla Valdéz[a*], Juan Frausto Solís[a], Moisés Israel Herrera Ramos[a], Juan Javier González Barbosa[a], Leonor Hernández Ramírez[a]

[a]División de Estudios de Postgrado e Investigación
TECNM/INSTITUTO TECNOLÓGICO DE CIUDAD MADERO
Av. 1º de Mayo esq. Sor Juana Ines de la Cruz s/n Col. Los Mangos C.P.89440
Cd. Madero Tamaulipas, México
* Correspondance author: gpe_cas@yahoo.com.mx

Abstract. The forecasting time series problem arises in important areas such as energy and finance. For this problem, the classical methods as ARIMA are very popular. However, these methods do not always find a good estimation of future events, and then optimization algorithms as those named neuroevolutionary algorithms can be a good alternative. NEAT is a very popular neuroevolutionary forecasting method. Forecasting time series is, an optimization problem, where the objective is to estimate by minimizing the forecasting error; besides, Simulated Annealing (SA) and Genetic Algorithms (GA) are very successful heuristic algorithms. The Makridakis competition is commonly used for testing time series algorithms; however, neuroevolutionary algorithms have not been tested with this kind of series. In this paper, we propose a hybrid forecasting algorithm NeuroSAGA which uses neuroevolution, SA, and GA; in fact, NeuroSAGA is a neuroevolutionary algorithm just like NEAT. We compare the proposed algorithm with NEAT and the most successful M3 Makridakis Competition algorithms. We experiment with all the time series belonging to M3, and we show that the proposed method surpasses both, NEAT and ARIMA algorithms.

Keywords: Neuroevolution, Simulated Annealing, Time Series Forecasting, Genetic Algorithm.

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Multi-objective optimization of a CMOS OTA's linearity for chaotic oscillators

Martín Alejandro Valencia Ponce 1[a], Esteban Tlelo Cuautle 2[a], Luis Gerardo de la Fraga 3[b]

[a]Electronic Department,National Institute of Astrophysics, Optics and Electronics
Luis Enrique Erro 1, Tonantzintla, Puebla, México
alejandroponce@inaoep.mx,etlelo@inaoep.mx

[b]Computer Science Department, Cinvestav
Av. IPN 2508, 07360 Mexico City, México
fraga@cs.cinvestav.mx

Chaotic oscillators are dynamic systems that can be modeled by state equations in the form of initial value problems. Their main characteristic is that they are highly sensitive to initial conditions, and a small difference causes random and disorderly behavior. For that reason, these systems are suitable for cryptography [1] and ciber-security portable applications [2]. However, the electronic implementation of chaotic oscillators is a challenge, due to the complexity and few margin of error that exists in the integrated circuit design [3]. One of the main blocks in the chaotic oscillator circuit design are the operational transconductance amplifiers (OTAs) that can be designed by using complementary-metal-oxide-semiconductor (CMOS) integrated circuit technology. Nevertheless, a small variation in the OTA parameters or in the MOS transistor sizes may suppress the chaotic behavior. In this manner, we demonstrate the usefulness of a multi-objective optimization algorithm to improve the linearity and differential gain of an OTA for generate continuous-time chaotic behavior, guaranteeing robustness to process, voltage, temperature (PVT) and Monet Carlo analysis [4]. Moreover, we introduce the integrated circuit design of the chaotic system, layout and post-layout simulations using CMOS UMC 180 nm technology.

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A Genetic Algorithm to Effectively Design Musical Counterpoints

Natan Vilchis-Tavera[a], **Adriana Lara**[a]

[a]Escuela Superior de Física y Matemáticas
Instituto Politécnico Nacional
Edificio 9, unidad Profesional ALM, Zacatenco, cp 07300, del. GAM. Mexico City, Mexico
nvilchist1300@ipn.mx, alaral@ipn.mx

We present in this work an automatic generator of musical counterpoints. Using a genetic algorithm, we obtained an artificial intelligence to automatically design a counterpoint after a given melody (*cantus firmus*). One of the goals was handling *cantus firmus* containing any musical phrase, i.e., variable melody length, diverse temporal figures, and silences. We will show and play our obtained results over some classical melodies and emphasize critical aspects for the computational implementation and future work challenges on this topic.

Comparison between classical model and data driven model of the first order kinematic control for a redundant robot

Josué Gómez * **América Morales** * **Chidentree Treesatayapun** *

* *Robotics and Advanced Manufacturing Programm CINVESTAV-Saltillo, Ramos Arizpe, 25903, México (e-mail:josuegomezcasas@gmail.com).*

Abstract: This paper proposes a comparison between the conventional model and data driven model for a first order kinematic control of a redundant robot. For a kinematic control the Jacobian matrix represents the model. The conventional model requires to know the parameters for the Denavit-Hartenberg convention, based on the analysis in the coordinate frames of the joints to know the position of the end-effector and solving the forward kinematic problem. In this sense the Jacobian matrix is computed. In contrast, the data driven model considers the robot as unknown system using the real time input-output signals to approximate the Jacobian matrix on-line by an estimation method. The objective of this paper is to demonstrate the main differences between both methods of modelling by means simulations and using a typical proportional control to focus on the modelling facts.

Optimizing the energy for an industrial robotic arm manipulator using Particle Swarm Optimization algorithm

Salvador Enrique Lobato Larios and Juan Gabriel Ruiz Ruiz

Computer Department
Universidad de la Sierra Juárez
Av. Universidad S/N. Ixtlán de Juárez, Oaxaca, México
salvadorl@unsij.edu.mx, jugaruiz@unsij.edu.mx

Abstract

Repetitive processes are found in different industrial applications such as inspection, welding, painting, assembling and moving objects, the performance of robot manipulators is always affected due to the velocity variations causing vibrations, physical damages, instabilities, and finally the increase of the consumption of energy. This paper considers a solution to the problem of moving a robot manipulator with a minimum cost along a specified path. The optimal cost function is considered applying particle swarm optimization algorithm to improve the Lyapunov control to reduce robot instabilities.

Keywords: Particle Swarm Optimization, Robotics, Lyapunov control.

FPGAS as efficient accelerators for the implementation of heterogeneous computing

Rogelio Valdez[a], **Yazmin Maldonado**[b]

Department of Electrical and Electronic Engineering
Posgrado en Ciencias de la Ingeniería
Instituto Tecnológico de Tijuana
Tijuana, Baja California, Mexico
rogelio.valdez17@tectijuana.edu.mx
yaz.maldonado@tectijuana.edu.mx

The modern large-scale computing systems such as data centers, supercomputers, cloud configurations, among others, employ heterogeneous architectures that consist of CPU (Central Processing Unit), GPU (Graphics Processing Unit) and FPGA (Field Programmable Gate Array). The effective use of these architectures has several challenges, the main one is the energy consumption. By adopting FPGA hardware accelerators, their characteristics can be exploited to achieve significant energy savings. Recent studies show that the power reduction can reach 12% on multi-core CPUs, 20% on GPUs and 39% on FPGAs [1]. Heterogeneous computing is the heart of most high-performance computing nodes, due to its energy efficiency and performance. However, programming is still a challenge considering that it is necessary to program devices with different architectures in software and hardware. Commonly, heterogeneous computing consist of a CPU and an accelerator. The GPU is the most widely used accelerator because it offers excellent performance for multiple applications. However, GPU require considerable power consumption. Consequently, and trying to correct the energy consumption, there are other accelerators who are fighting, such as the Systems on Chips (SoCs) with FPGAs. Compared to other accelerators, FPGAs can provide lower energy consumption, however, the disadvantage is that the knowledge of digital design is required for their programming, which becomes the main reason for not using it.

However, the programming of these hardware platforms is not trivial, you must have advanced knowledge of software programming, in addition to know about digital systems and hardware description languages, so it is necessary to design a framework for heterogeneous architecture using a FPGA as hardware accelerator, achieving optimal synchronization between the different devices with the advantage of not being an expert in digital systems and hardware description language for its use.

Until today, heterogeneous computing is indispensable when it comes to solving problems that require high computational performance. The most widely used accelerators are CPUs and GPUs for their easy programming. These devices offer many advantages in their programming, because working with languages such as C/C++, OpenCL, Java and others languages. The state-of-the-art mention that these accelerators consumes a lot of energy and also generates bottlenecks between the communication of the CPU and GPU. So recently the FPGA has emerged as an accelerator, which has shown that their power consumption is lower compared to other accelerators. With this, a new problem emerges, because is necessary to know FPGA programming in VHDL (Very High Speed Integrated Circuit Hardware Description Language) or Verilog, but this is not simple because you have to have knowledge about digital design.

To reach this goal, we propose to design a framework for heterogeneous computing using an FPGA as an accelerator, synchronizing the different devices in the best way. With the framework, the designer will not have to know about FPGA programming since it is planned that the framework is programmed in C or C ++. To evaluate the performance of the framework we will use the Mirovia benchmark [2], this benchmark contains a wide collection of problems that will allow us to measure energy performance. For this, it will be necessary to extend the Mirovia implementation to FPGAs because Mirovia has only been used for heterogeneous computing with CPU and GPU.

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Optimizing the Operating Personnel Costs at Boschś Toluca plant

David Laredo Razo[a]

[a]Department of Industry 4.0
Bosch Toluca Plant
Roberto Bosch 405, Zona Industrial, 50070 Toluca de Lerdo, Méx.
David.LaredoRazo@mx.bosch.com

Operating personnel costs (OPC), i.e., the expenses related to the number of people working in a production line, are often one of the most expensive costs associated with the daily operation of the Bosch manufacturing plant at Toluca. Minimizing the number of people working at a production line within the plant can result in a large positive economic impact for the plant and is therefore of particular interest for the plantś management. Nevertheless, estimating the number of minimal people working at a specific production line is often difficult since it depends on multiple factors such as: the production plan (which usually varies from week to week), the overtime required in order to satisfy the production plan (overtime is costlier than normal working hours), the number of shifts allowed per day and the duration of such shifts, among other constraints. Furthermore, there are many products that can be produced at more than one line; when this is the case the single-objective problem (SOP) of minimizing the number of people in a line becomes a bi-objective problem (BOP) where we simultaneously try to minimize the number of people at each line, while maximizing the number of parts produced at a given line according to a pre-defined part-to-line priority. In this paper, we aim at developing a method for computing an efficient solution to the OPC problem. First, we propose a mathematical model that accurately captures all the interactions between the different variables involved in the OPC computation; then, we apply a combination of a genetic algorithm with a pattern search method to find the best solution for the OPC problem. The results show that our method is both efficient and accurate.

Explicit Multi-objective Model Predictive Control for Nonlinear Systems Under Uncertainty

Carlos Hernández Castellanos[a], **Sina Ober-Blöbaum**[b], **Sebastian Peitz** [b]

[a]Departamento de Computación
CINVESTAV-IPN
Mexico City, Mexico
chernandez@computacion.cs.cinvestav.mx

[b]Department of Mathematics
Paderborn University
Paderborn, Germany
{sinaober,speitz}@math.uni-paderborn.de

In many real-world engineering problems, uncertainties (e.g., errors in the measurement, precision errors, among others) often lead to poor performance of numerical algorithms when not explicitly taken into account. This is also the case for control problems, where in the case of uncertainties, optimal solutions can degrade in quality or they can even become infeasible. Thus, there is the need to design methods that can handle uncertainty.
In this work, we study nonlinear uncertain multi-objective optimal control problems in the sense of *set-based minmax robustness* [1]. In particular, we consider nonlinear multi-objective optimal control problems with uncertainty on the initial conditions, and their incorporation into a feedback loop via model predictive control (MPC). For such problems, not much has been reported in terms of uncertainties. To address this problem class, we design an offline/online framework to compute an approximation of efficient control strategies.
As multi-objective optimization problems usually cannot be solved in real-time, we use ideas from explicit MPC for nonlinear systems, where a library of solutions is computed in an offline phase for many different initial conditions. In order to reduce the numerical cost of this phase phase – which grows exponentially with the parameter dimension – we exploit symmetries in the control problems [2]. Furthermore, in order to ensure optimality of the solutions, we include an additional online optimization step [3], which is considerably cheaper than the original multi-objective optimization problem.
We test our framework on a car maneuvering problem where safety and speed are the objectives. The multi-objective framework allows for online adaptations of the desired objective. Our results show that the method is capable of designing driving strategies that deal better with uncertainties in the initial conditions, which translates into potentially safer and faster driving strategies.

Acknowledgments CIHC acknowledges Conacyt for funding no. 711172. SP acknowledges support by the DFG Priority Programme 1962.

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Modeling of a Steam Turbine through Neural Network Training using Genetic Algorithms

Y. El Hamzaoui, J. A. Alvarez Arellano, and J.A. Rodriguez

This paper deals with the analysis and predictions of the Useful Life UL of steam turbine made by General Electric, which has a 110MW generation capacity using machine learning. The aim of this work is to develop an integrated approach about neural network training using genetic algorithms to predict the UL under different operating conditions as damping, natural frequency, vibration magnitudes, density, pressure, temperature, mass flow and enthalpy. The proposed method is a new tool combining neural networks with genetic algorithms. This paper investigates the possibility of using genetic algorithms in the last stage of the design of a neural network which serves to predict the life testing into their respective regressions analysis. In this stage, it trained feed forward neural network with a fixed architecture to perform this prediction. Most neural networks of this type were trained using a steepest descent learning algorithm, usually referred to as the backpropagation algorithms. Since genetic algorithms could find good solutions for most optimization problems, we investigated this technique in this paper as to their performance and viability into the field of neural networks parameters optimization. Results show that training neural networks using genetic algorithms outperforms ten other training algorithms including Levenberg-Marquardt, Bayesian Regularization and Scalled Conjugate Gradient algorithms. Therefore, this technique makes up a promising framework for the automatic modeling in this domain.

Keywords: Steam turbine, useful life, neural networks, genetic algorithms

Generation of virtual maps of the solar resource in the State of Chiapas, México

Víctor Ramos Fon Bon[1], Roberto Horacio Albores Arzate[2], Manuel Palacios Gallegos[1], Edalí Camacho Ruiz[3], Cristina Blanco González[1], Aremi Olaya Virrueta Gordillo[1]

[1]Universidad Politécnica de Chiapas.
[2]Facultad de Ingeniería en el programa educativo de ingeniería topográfica e hidrología de la Universidad de Ciencias y Artes de Chiapas.
[3]Facultad de Ingeniería en el programa educativo de ingeniería ambiental de la Universidad de Ciencias y Artes de Chiapas.

Abstract

The Universidad de ciencias y artes de Chiapas, sponsored by Conacyt's project 259306 "Proyecto piloto de edificaciones con balance cero", develops a software tool that provides information in a visual and friendly manner; generating virtual solar radiation maps. In order to implement this software tool and provide a solar radiation prediction, a mathematic model was generated performing a statistics analysis using a correlation between four weather stations in Chiapas state. The virtual maps can be generated with different level of detail of any region of Chiapas, a tool that provides the solar potential provides high value information to researchers and academics, as well as any individual or organization that requires this kind of information from regions or locations where is impractical or insecure to place weather stations to obtain solar radiation data. This software application will support activities related to solar sustainability, the information generated could be used as a reference of the solar resources available in Chiapas. It will also help to model prototypes of application technology components and systems, because can be used to simulate the results before taking them to production.

Keywords: solar map, statistical analysis, software technology.

Optimizing Roof-gardens Location for Mexico City Air Quality Improvement

Fernando Moreno-Gómez[a], Adriana Lara[a]

[a]Escuela Superior de Física y Matemáticas
Instituto Politécnico Nacional
Edificio 9, unidad Profesional ALM, Zacatenco, cp 07300, del. GAM. Mexico City, Mexico
fmorenog0901@alumno.ipn.mx, alaral@ipn.mx

The lack of green zones in urban cities has been related to temperature variations and lousy air quality. Pollution is a critical problem in Mexico City, affecting every kind of life on it [1,2,3,4]. In this work, we present a model for green zones' influence on air quality in some regions of Mexico City. The goal is to maximize the air quality improvement according to roof gardens' settlement in specific neighborhoods. We use a Genetic Algorithm to explore a sizeable solution-search space and determine the best location to intervene in the urban area. The data used in this study comes from the Mexican System of Atmospheric Monitoring (SIMAT) related to regional wind and air quality over the last five years.

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Optimization management for electric power grids based on a linear model

Esmeralda López-Garza[a], **René Domínguez-Cruz**[a], **Iván Salgado-Tránsito**[b]

[a]Center for Technological Innovation in Electrical and Electronics
Autonomous University of Tamaulipas
Carr. Reynosa - San Fernando, cruce con Canal Lateral, Arcoíris, C.P. 88779 Reynosa, Tamps.
elgarza@uat.edu.mx, rfdominguez@uat.edu.mx

[b]Solar Research and Engineering Group
Research Center in Optics. Campus Aguascalientes
Prolongación Constitución # 607, Fracc. Reserva Loma Bonita, C.P. 20200, Aguascalientes Ags.
isalgadotr@cio.mx

The optimal production and consumption of energy resources is a priority matter because, if there is not a timely forecast, it can have impacts either on the depletion of resources, environmental effects or on the saving of production expenses, etc. For this reason, it is essential to have mathematical tools that allow predicting possible scenarios. This type of model turns out to be an instrument for decision-makers and thereby establish sustainable policies and strategies. This paper presents the preliminary results of a study of seventeen interconnected power generation plants located in eastern Mexico. The objective is to apply a mathematical model of linear programming that allows finding the optimal solution for the system by minimizing operating costs. The analytical model considers restrictions with specific real parameters of each plant, described in four periods that satisfy the demand requested in each one. The proposed study provides results in the efficient administration of available resources obtained from a simple implementation model. The contribution of this case study lies in the use of real data from the plants involved in power generation in the region described. The results presented to allow them to be used as an instrument in decision-making regarding the rational use of available installed capacity.

Optimization of the Multi-objective Project Selection Problem with Type Interval Fuzzy Parameters

Héctor Fraire-Huacuja, Daniela López-García, Laura Cruz-Reyes, Nelson Rangel-Valdez, Claudia Guadalupe Gómez-Santillán, María Lucila Morales-Rodríguez, Fausto Antonio Balderas-Jaramillo

Tecnológico Nacional de México/Instituto Tecnológico de Ciudad Madero, Cd. Madero, Tamaulipas, MÉXICO.
automatas2002@yahoo.com.mx

Abstract. In this presentation, we approach the Project Selection Multi-objective Problem with type interval fuzzy parameters. As to the best of our knowledge, in the literature, only is reported a solution algorithm that uses crowding distance as a density estimator. In this work, we propose substituting this estimator for the Spatial Spread Deviation to improve the distribution of the solutions in the Pareto fronts. We propose to apply a defuzzification process to the solutions in the generated fronts to measure the algorithm performance using the commonly used metrics. The computational experiments use a set of problem instances and the metrics of hypervolume and generalized spread. The results obtained are encouraging as they confirm the feasibility of the proposed approach.
Keywords: Multi-objective Optimization, Project Selection Multi-objective Problem, Density Estimators.

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Chaotic Multi-Objective Simulated Annealing and Threshold Accepting for Job Shop Scheduling Problem

Leonor Hernández Ramírez[a], Juan Frausto Solís[a*], Guadalupe Castilla Valdéz[a] Juan Javier González Barbosa[a], Juan Paulo Sánchez-Hernández[b]

[a]División de Estudios de Postgrado e Investigación
TECNM/INSTITUTO TECNOLÓGICO DE CIUDAD MADERO
Av. 1^o de Mayo esq. Sor Juana Ines de la Cruz s/n Col. Los Mangos C.P.89440
Cd. Madero Tamaulipas, México
[*] juan.frausto@gmail.com

[b]Dirección de Informática, Electrónica y Telecomunicaciones
Universidad Politécnica del Estado de Morelos
Boulevard Cuauhnáhuac 566, Jiutepec 62574, México
juan.paulosh@upemor.edu.mx

Abstract. The Job Shop Scheduling Problem (JSSP) has enormous industrial applicability; this problem refers to a set of jobs which need to be processed in a specific order in a set of machines. For the Single objective optimization JSSP problem, the Simulated Annealing is among the best algorithms. However, in the case of Multiobjective JSSP, these algorithms have barely been analyzed; even more, the Threshold Accepting Algorithms have not been yet published. Besides, researchers have not reported studies with more than two or three metrics for measuring the performance of algorithms for JSSP. In this paper, we present two JSSP Multiobjective metaheuristic based on Simulated Annealing: the Chaotic Multiobjective Simulated Annealing (CMOSA) and the Chaotic Multiobjective Threshold Accepting (CMOTA). The former algorithm is an extension of the classical MOSA for JSSP in which a chaotic perturbation process was included to improve its quality. We developed these algorithms to minimize three objectives: Makespan, tardiness, and total flow time. To evaluate the performance of the proposed CMOSA and CMOTA algorithms, we used 78 instances and six performance metrics, which significantly increases the number of instances and performance metrics used in research on Multiobjective JSSP. A Wilcoxon nonparametric statistical test was applied to compare the performance of the proposed algorithms and the state of the art algorithms. We conclude that these algorithms outperform the algorithms of the literature for the Multiobjective JSSP with the same number of objectives.
Keywords: JSSP, CMOSA, CMOTA, chaotic perturbation.

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An Experimental Study of Grouping Mutation Operators for the Unrelated Parallel-Machine Scheduling Problem

Octavio Ramos-Figueroa and Marcela Quiroz-Castellanos

Artificial Intelligence Research Center
University of Veracruz
Sebastian Camacho # 5, Centro, Xalapa, Veracruz, 91000, MÉXICO.
oivatco.rafo@gmail.com, maquiroz@uv.mx

The Grouping Genetic Algorithm (GGA) is an extension to the standard Genetic Algorithm that uses a group-based representation scheme and variation operators that work at the group-level. This metaheuristic is one of the most widely used algorithms to solve combinatorial optimization grouping problems. Its optimization process consists of different components, although the crossover and mutation operators are the most resent ones. This work provides a comparative experimental study of different mutation operators for a GGA designed to solve the parallel-machine scheduling problem with unrelated machines and makespan minimization ($R||C_{max}$). $R||C_{max}$ is a classic NP-hard problem that consists of looking for the most efficient sequential scheduling of a set of n jobs with no-preemptions among a collection of m unrelated parallel-machines to reduce the maximum completion time, i.e., the time required by the machine that finishes at the end to process its jobs. The objective of this work is to design an efficient grouping mutation operator through out a methodology that considers different aspects immersed in this kind of operators, to later incorporate it to the state-of-the-art GGA for $R||C_{max}$ to improve its performance [1]. The experimental design consists of four phases where the performance of the designed mutation operators are evaluated by solving 1400 test instances introduced by Fanjul-Peyro in 2010 [2]. The first stage covers the analysis of four state-of-the-art grouping mutation operators, so-known as Swap, Insertion, Merge & Split, and Elimination, to determine which one has the best performance for $R||C_{max}$. The second phase comprises an exploratory analysis of thirty-five combinations of numbers of machines and jobs involved in mutation operations. Stage three involves the assessment of four operators with different machine selection strategies, including biased, random, and mixed approaches. Finally, stage four contains a comparative study of four operators with distinct rearrangement heuristics based on insertion and interchange operations. The experimental results suggest that an efficient grouping mutation operator for $R||C_{max}$ should: (1) be based on the state-of-the-art Elimination operator, (2) remove few jobs from few machines, (3) incorporate a machine selection strategy that combines the bias with the randomness, and (4) employ a rearrangement heuristic that first tries to insert the jobs and then tries to swap them. Finally, the experimental results also indicate that our new grouping mutation operator improves the performance of the state-of-the-art GGA by 52%, which demonstrates that adding intelligence about the problem domain enhances the performance of a GGA.

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November 19, 2020 ==========

On the treatment of optimization problems with L1 penalty terms via multiobjective continuation

Katharina Bieker[a,b], **Bennet Gebken**[a], **Sebastian Peitz**[a]

[a]Institute of Mathematics
Paderborn University
Warburger Straße 100, 33098 Paderborn
[b]bieker@math.upb.de

In many areas it is of great importance to find sparse models, especially in image and signal processing, machine learning and medical imaging. One of the motivations is to ensure robustness against noisy data, but also to find models that are as simple as possible and therefore easier to interpret. It is common practice to assess the sparsity using the l^1-norm and to solve the problem using a regularization parameter, i.e. $f(x) + \lambda\|x\|_1$ with $\lambda \in (0,1)$ is solved.
In order to gain a better understanding and to allow for an informed model selection, we will not use this weighted-sum approach. Instead, we aim at solving the corresponding multiobjective optimization problem, i.e.

$$\min_{x\in\mathbb{R}^n} \begin{pmatrix} f(x) \\ \|x\|_1 \end{pmatrix}.$$

We will present a Continuation Method, which is specifically tailored to the l^1-norm as a second objective function and discuss the advantages but also future challenges of our method in practice.

Derivative-Free Multiobjective Trust Region Descent Method Using Radial Basis Function Surrogate Models

Manuel Berkemeier[a] , **Sebastian Peitz**[b]

Institute of Mathematics
[a,b]Paderborn University
Warburger Str. 100, 33098 Paderborn
[a]manuelbb@math.upb.de

We present a flexible trust region descend algorithm for unconstrained multiobjective optimization problems. It is targeted at heterogeneous problems, i.e. problems that consist of at least one *expensive* objective function which can occur in contexts where time-consuming simulations need to be evaluated.
The method is derivative-free in the sense that we neither need derivative information nor do we need to approximate the gradients using repeated function evaluations as is the case in finite-difference methods. Instead a multiobjective trust region approach is used that works similarly to its well-known scalar pendants. Local surrogate models of the true objective functions are employed to compute possible descent directions. In contrast to existing multiobjective trust region algorithms, these surrogates are not polynomial but carefully constructed radial basis function networks. The local models qualify as *fully linear* and the corresponding scalar framework is adapted for problems with multiple objectives. Due to the choice of surrogate models and the techniques borrowed from the scalar framework, expensive function evaluations can be avoided. Convergence to Pareto critical points is proven and numerical examples illustrate our findings.
Additionally, some modifications are proposed as how to incorporate convex domain constraints (most importantly box constraints) or alternative ways to compute a descent direction.

Archiving Strategies for Multi-objective Evolutionary Algorithms

Carlos Hernández and Oliver Schütze

Computer Science Department
Cinvestav-IPN
Mexico City, Mexico
chernandez@computacion.cs.cinvestav.mx, schuetze@cs.cinvestav.mx

In this presentation we give an overview of several archiving strategies we have developed over the last years dealing with approximations of the solution sets of multi-objective optimization problems by stochastic search algorithms ([1]). More precisely, we will present and analyze several archiving strategies that aim for different finite size approximations either of the set of optimal solutions (Pareto set and front) as well as the set of approximate solutions of a given optimization problem. The convergence analysis will be done for a very broad framework that includes all existing stochastic search algorithms (such as evolutionary algorithms, subdivision, and cell mapping techniques) and that will only use minimal assumptions on the process to generate new candidate solutions. As it will be seen, already small changes in the design of the archivers can have significant effects on the respective limit archives. It is important to note that all of the archivers presented here can be coupled with any set-based multi-objective search algorithm, and that the resulting hybrid method takes over the convergence properties of the used archiver.

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Comparison of archive pruning strategies for the multi-objective optimization of stand-alone electrification systems

A. Ponsich[a], **B. Domenech**[b], **L. Ferrer-Martí**[b], **A. García-Villoria**[b], **R. Pastor**[b]

[a]Departamento de Sistemas
Universidad Autónoma Meropolitana – Azcapotzalco
Mexico City, C.P. 02200, Mexico
aspo@azc.uam.mx

[b]Instituto de Organización y Control de Sistemas Industriales
Universitat Politècnica de Catalunya – BarcelonaTech
Barcelona, 08028, Spain
{bruno.domenech, laia.ferrer, alberto.garcia-villoria, rafael.pastor}@upc.edu

Nowadays, most people without access to electricity are concentrated in rural and isolated areas, located far from national electricity networks. In these cases, stand-alone electrification systems based on renewable energies (solar and wind, mainly) constitute a promising strategy, already implemented in many contexts worldwide. The design of such systems involves determining the location and sizing of power generation equipment, as well as the connections forming distribution microgrids. This is generally formulated as an optimization problem minimizing the installation costs, while granting specified energy and power supply. In this work, a multi-objective optimization (MO) approach is proposed, considering the maximization of energy and power supplied as additional objectives. This way, decision-makers may choose, among a set of efficient solutions, the configuration most adapted to the energy needs of population and the economic resources available. First, a heuristic devoted to microgrid-based system design [1], combined with the ε-constraint method, is employed to obtain a set of non-dominated solutions. However, since the size of this latter (containing, potentially, hundreds of solutions) is too high to allow for a proper decision-making process, several strategies are compared to reduce the set of options presented to decision-makers.
Archive maintenance in MO algorithms has been widely studied, mostly through ε-dominance ($\succ_\varepsilon$) and diversity preservation (in objective and/or decision spaces) [2]. Here, two diversity indicators are compared (crowding distance and crowding degree), as well as a technique based on similarity with evenly distributed reference points. Further, a pre-processing step based on ε-dominance, modified in order to avoid some drawbacks of the $\succ_\varepsilon$ operator, may be included before the application of the three pruning techniques. The resulting strategies are evaluated for the electrification of two rural communities from Peru highlands. The obtained decision-making sets are compared in terms of hypervolume, Inverted Generational Distance (showing how much the selected solutions are representative of the initial set) and spacing. Numerical results prove that the ε-dominance based filter allows significant performance improvements, while the crowding distance achieves the overall best results, particulary regarding the hypervolume indicator.

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Optimal design of a wind turbine blade based on its mass, in the domain of stress and tip speed ratio

Zavala-Morales J.[a], **Cadenas-Calderón, E.** [b], **Campos-Amezcua, R.**[c]

[a]Faculty of Mechanical Engineering
Universidad Michoacana de San Nicolás de Hidalgo
Santiago Tapia 403, Centro, 58000 Morelia, Mich.
1731329j@umich.mx

[b]Faculty of Mechanical Engineering
Universidad Michoacana de San Nicolás de Hidalgo
Santiago Tapia 403, Centro, 58000 Morelia, Mich.
ecadenas@umich.mx

[c]National Center for Technological Research and Development
Tecnológico Nacional de México
Interior Internado Palmira S/N, Col. Palmira, Cuernavaca 62490, México
rafael.ca@cenidet.tecnm.mx

Abstract

The optimal design process of a wind turbine blade is presented, with the objective of finding a mathematical function that allows generating multiple designs of different masses, which accomplish with the restrictions found in the domain of the von Mises stress and the tip speed ratio. To generate the aerodynamic and structural design of the blade used in the optimal design process, the BEM theory was used. A turbine power of 30 kW and an aerodynamic profile NRELS818 were taken as parameters. To know the mechanical behavior of the blades, finite element simulations were carried out, using three load hypotheses, under the UNE-EN 61400-2 standard. The objective function found provides a design region of the blades in which those designs of different masses that satisfy the constraints of stress and tip speed ratio co-exist. The above should be used as a support to generate wind turbine blades in optimal conditions and reduce manufacturing costs.

Existence of multifractality in wind speed time series

Méndez-Gordillo Alma Rosa[a], Rafael Campos-Amezcua[b], Cadenas Erasmo[c]

[a]Faculty of Mechanical Engineering
Universidad Michoacana de San Nicolás de Hidalgo
Santiago Tapia 403, Centro, 58000 Morelia, Mich.
alma.mendez@umich.mx

[b]Centro Nacional de Investigación y Desarrollo Tecnológico
Tecnológico Nacional de México
Interior Internado Palmira S/N, Col. Palmira, Cuernavaca 62490, Mexico
rafael.ca@cenidet.tecnm.mx

[c]Faculty of Mechanical Engineering
Universidad Michoacana de San Nicolás de Hidalgo
Santiago Tapia 403, Centro, 58000 Morelia, Mich.
ecadenas@umich.mx

The Multifractal Detrended Fluctuation Analysis (MF-DFA) method proposed by J.W Kantelhardt and H. E. Stanley, allows to identify the complexity and variability of a wind speed time series. The objective of the present work is to analyze an hourly wind time series, using the MF-DFA technique, in order to increase the knowledge regarding of the fractal nature of the wind. All measurements were taken by the Comision Federal de Electricidad (CFE) at Ixtepec, México in the year 2005. The existence of multifractality in a wind speed time series is characterized by the study of the different Hurst coefficients in the curves once the data have been processed. As well as the decrement H_q of the Hurst exponent of order q and the behavior of the singularity spectrum. Therefore, it is possible to conclude that the MF-DFA technique is suitable for describing the existence of multifractality in the analyzed wind speed time series.

Key Words: Wind speed time series, multifractality, MF-DFA

Development of a methodology to optimize low-power wind energy harvesting

Julio Cesar Solís Sánchez[1], Manuel Palacios Gallegos[2], Roberto Horacio Albores Arzate[3], Cristina Blanco González[2], Adalí Camacho Ruiz[4], Víctor Ramos Fon Bon[2], Aremi Olaya Virrueta Gordillo[2], Josué Chanona Soto[2].

[1]Colegio de Bachilleres de Chiapas. Plantel 20.
[2]Universidad Politécnica de Chiapas.
[3]Facultad de Ingeniería en el programa educativo de ingeniería topográfica e hidrología de la Universidad de Ciencias y Artes de Chiapas.
[4]Facultad de Ingeniería en el programa educativo de ingeniería ambiental de la Universidad de Ciencias y Artes de Chiapas.

Abstract

This paper presents a methodology developed for the evaluation of the wind potential when using low power devices to take advantage of the resource. For the quantitative analysis, three models of wind turbines were considered, one of our own design and two commercial ones; also, two locations belonging to the Universidad del Istmo in the state of Oaxaca, Mexico were selected for the study, the Juchitán Campus and the Tehuantepec Campus. Seven wind databases from weather stations near to the locations were used to provide data such as direction and wind speed, the data was used to determine the predominant wind direction and the wind power density. The proposed model considers orographic and roughness data from the locations to extrapolate the wind data, which were validated using the measurements taken from the INEEL meteorological tower. Maps of the distribution of the wind resource of the locations, considering a height of 12 and 20 meters, were developed applying an inverted distance weighting model and WindPro software.

The results show values of wind power density of 283.61 W / m^2 for the Juchitán campus, and for the Tehuantepec Campus, a power density value of 148 W / m^2. These results were used to evaluate 3 wind turbine models: 1) a design from the Polytechnic University of Chiapas and two commercial models, 2) EvanceWind 5kW from Evance Wind Turbines Ltd and 3) Aeolos H-5 from Aeolos Wind turbine. The results showed that the 5 kW UPCh model presented a better performance, because the design considers the local wind conditions; this model obtained an annual energy production estimate of 14.59 ± 1.74 MWh / year in the Juchitán Campus and of 9.13 ± 1.63 MWh / year at the Tehuantepec Campus. Finally, this study also included an evaluation of environmental impacts due to noise emission and shadow projection, the evaluation shows a minimal environmental impact for the study locations.

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Key Words: Wind resource, wind turbine, energy production, environmental impact,

Numerical and experimental analysis of the near wake behind a small wind turbine rotor

Marcos Hernández[a], Rafael Campos Amezcua[b], Roberto Gómez[c], Hugo Abundis[d], Luis Trujillo[e], Luis Palacios[d]

[a]Maestría en Ingeniería Mecánica
Instituto Tecnológico de Pachuca

[b]Departamento de Ingeniería Mecánica
Tecnológico Nacional de México/Centro Nacional de Investigación y Desarrollo Tecnológico

[c]Instituto de Ingeniería
Universidad Nacional Autónoma de México

[d]División de Estudios de Posgrado e Investigación
Tecnológico Nacional de México/Instituto Tecnológico de Pachuca

[e]Licenciatura en Ingeniería Mecánica Automotríz
Universidad Politécnica de Pachuca

This work presents a numerical and experimental study of the near wake behind the rotor of a small horizontal axis wind turbine. The results were obtained using the open source software OpenFoam version 19.10 and the commercial software Ansys-Fluent version 2020 R1. The objective of this study is to compare the different existing tools for solving these types of problems, with one widely known, accepted and user-friendly commercial software against an open source software that is on the rise, despite not being user friendly. Both results were compared with each other and validated with experimental tests carried out in an atmospheric boundary layer wind tunnel.

The results analysis included the convergence of the results, robustness and stability of the solution, calculation time, the precision of the magnitude of variables of interest such as pressure, speed, circulation, vorticity, turbulent kinetic energy, dissipation rate, etc.

The results show that the numerical studies carried out in both commercial and open source softwares have a similar level of precision for the cases studied. Therefore, we can make professional use of this open source tool with the objective of redesign the geometry of the wind turbine and thus optimizing the energy transformation that occurs in these systems.

Effect of the profile of the decision maker in the search for solutions in the decision-making process

Mercedes Perez-Villafuerte[a], Laura Cruz-Reyes[b], Nelson Rangel-Valdez[b]
Claudia Gomez-Santillan[b], Hector J. Fraire-Huacuja[b]

[a]Department of Computing Science
Tijuana Institute of Technology
Calzada del Tecnologico, Fraccionamiento Tomas Aquino, Tijuana, Mexico
pvmercedes@gmail.com

[b]Department of postgraduate and investigation studies
Technological Instutite of Madero City
Juventino Rosas 114, Los Mangos, Madero City, Mexico
cruzreyeslaura@itcm.edu.mx

In the decision-making process there is a promising variant, the incorporation of preferences, specifically using the a priori methodology, which has the advantage of delimiting the search space for an optimal solution. However, it has been found in the specialized literature that this part of arbitrary reference sets, which are examples of random solutions. In this work, it is proposed that these sets of references are not arbitrary and that instead, they are associated with profiles that characterize decision makers.
As part of the proposed solution in the decision-making process, a modularized architecture called P-HMCSGA is presented for multi-criteria optimization with satisfaction of preferences specified in a preferential profile. P-HMCSGA consists of three phases: it initiates with the generation of a reference set for a specified profile, then follows the transformation of these indirect preferences into parameters of a preferential model [1] using a methodology of Preference Disaggregation Analysis (PDA) [2]. Finally, these preferences are incorporated into the search process of a multiobjective optimization algorithm [3].

In this work, the effect of the profile of a decision maker in the search process is studied; as part of the study, preferential profiles are introduced that represent some characteristics of the decision maker. These profiles are proposed as case studies to validate the proposed architecture. The objective of this work is to study whether there is a change in the solutions obtained in the optimization by allowing the decision maker to express their preferences through these profiles, and how these are translated into parameters of a preferential model based on characterizing it according to some profile. In order to execute the experiment, instances of the public portfolio problems were used as a case of study in medium and large scale. The result of this study showed that the highest number of satisfactory solutions are obtained using parameters according to that profile during the search and as a corollary it is found that the set of solutions for one profile may not be satisfactory for the specifications of another profile.

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a multi-criteria classification method. *Applied Soft Computing*, 50(50):48-57, 2017. ISSN.

Interactive recommendation system for the multiobjective project portfolio problem based on the characterization of cognitive tasks

Teodoro Macias-Escobar, Laura Cruz-Reyes, Cesar Medina-Trejo, Claudia Gómez-Santillán, Nelson Rangel-Valdez, Héctor Fraire

Division of Postgraduate Studies and Research
Instituto Tecnológico de Ciudad Madero
Av. 1o. de Mayo esq. Sor Juana Inés de la Cruz s/n Col.
Los Mangos, Cd. Madero, Tamulipas, México
lauracruzreyes@itcm.edu.mx

The decision-making process is complex and underestimated; when it is not appropriately addressed, it could result in poor results and excessive spending. This situation appears in the context of highly complex multi-criteria (multiobjective) problems such as the project portfolio selection (PPS) problem.

A portfolio of projects is a set of projects selected for future implementation. These projects share the resources currently available, and there is the possibility that several of those projects complement each other, as they are effective in the same area or region. It is necessary to know which set of projects meet the demands of an organization and maximize its profit; this is known as the PPS problem. The factors to be considered in PPS problems are the preferences of the decision maker concerning each of the available projects, and budget constraints [1][2]. The multicriteria decision analysis (MCDA) methods are one of the most widely used tools for solving PPS problems because of its capacity to handle highly complex problems.

Therefore, a recommender system becomes crucial to guide the solution search process. Although some previous researches, like developed in [3][4], focus on the solution of a choice selection problem and are based on argumentation theory, only [5] and this work are focused on PPS problems. Besides, other prototypes of recommendation systems are only described conceptually, whereas, in this work, a functional prototype is constructed, which includes the TOPSIS method [6] within the set of available MCDAs as proof standards, which has not been used in any of the reviewed papers. In general, there is a lack of work regarding system-user interaction to improve the solution search process on multi-criteria optimization problems.

This work studies the characterization of cognitive tasks involved in the decision-aiding process to propose a framework for the design of a decision aid interactive recommender systems (DAIRS). We focus on a system-user interaction that guides the search for the best solution considering the preferences of a decision maker. The use of argumentation schemes and proof standards allows a better understanding of the problem for the user, and to quickly identify the best fitting solution according to the preferences and restrictions defined by said user. The integration of these artifacts into several state transition diagrams allows a more flexible dialogue game between system and user, not only to know which solution is the best but also to understand the reasons for this selection.

El framework is validated through the construction of a prototype of DAIRS. The user experience of the proposed DAIRS is evaluated on real-life cases of the PPS problem via real users, particularly by considering human factors that affect the acceptance of the recommendation. A usability evaluation was achieved with the help of real users. They were asked to use the system for solving a PPS problem simulating a real-life situation. The results shown were satisfactory enough as the system received an approval of 89.91%. We consider that the prototype received a satisfying score

and a mostly overall acceptance by the test users.
There are some aspects that can be considered as future work such as the application the proposed framework on real problems different than the PPS problem; making the recommender system capable of receiving new user-made portfolios during the dialogue game; the addition of more MCDAs as proof standards; and lastly a more friendly-looking GUI.

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Core problem based heuristics for the probabilistic revenue management problem

Claudia O. López[a], **Emiliano Traversi**[b], **David C. Moreno**[c]

[a]Faculty of Sciences
UNAM
Exterior Circuit S/N, C.U., Mexico City, Mexico
claudia.lopez@ciencias.unam.mx

[b]LIPN
Université Sorbonne Paris Nord
99 Avenue Jean Baptiste Clément, 93430 Villetaneuse, France
emiliano.traversi@univ-paris13.fr

[a]Faculty of Sciences
UNAM
Exterior Circuit S/N, C.U., Mexico City, Mexico
chaffrey@ciencias.unam.mx

In this work we present a heuristic based on the core approach to solve the probabilistic revenue management problem from the multidimensional knapsack problem perspective. The core concept was first presented by Balas in [1] for the classical 0/1 knapsack problem. Later has been adapted for other types of knapsack problems as the multidimensional case studied by Puchinger in [12]. The main idea of this methodology is to reduce the size of the original integer/binary problem by fixing the value of some variables. Hence we work with a problem with less variables than the original and this is what we call the core problem. Della Croce in [6] developed an heuristic procedure embedding core problem approaches and a branching scheme based on reduced costs of the corresponding LP relaxation solution value.

The contributions of this work can be subsumed as follow: first we present a reformulation of the probabilistic revenue management problem that is a multidimensional knapsack problem with special structure and create benchmark data sets based on the OR ones given by Beasley in [5], second we complement the concept of core to the core-periphery structure for the multidimensional 0/1 knapsack problem and finally we exploit the special structure of the revenue management reformulation to develop an algorithm and an heuristic based in the concepts of core-periphery structure and core problem. Preliminary results in the benchmark data sets support our assumption that the proposed rules for the core-periphery structures yield to smaller core problems that obtains solutions of good quality in a relatively smaller amount of time.

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A Variant of Differential Evolution with Enhanced Diversity Maintenance

Joel Chacón Castillo[a], **Carlos Segura**[b]

[a]Computer Science Department
Center for Research in Mathematics (CIMAT)
Guanajuato, México
joelchaconcastillo@gmail.com

[b]Computer Science Department
Center for Research in Mathematics (CIMAT)
Guanajuato, México
carlos.segura@cimat.mx

Evolutionary Algorithms (EAS) are population-based meta-heuristics widely used in complex optimization problems. In spite of their remarkable performance, its behavior can be seriously deteriorated by several reasons. Premature convergence is one of the most important drawbacks that EAS face. A way to alleviate this drawback dwells in the incorporation of diversity management techniques with the aim of attaining a proper balance between exploration and exploitation [1]. In 2013, Črepinšek et al.[2] proposed a quite popular classification of these methods which depends on the sort of components modified in the EA. This taxonomy identifies the following groups: *selection-based*, *population-based*, *crossover/mutation-based*, *fitness-based*, and *replacement-based*. Some of the most successful methods designed in recent years to attain this balance yields in the *replacement-based* group. The basic principle that governs methods belonging to this group is the modification of the level of exploration in successive generations by controlling the diversity of the survivors. In this way, an adequate selection of diverse survivors might slow down the inconvenient of an accelerated convergence. Recent research has shown that important advances are attained when the balance between exploration and intensification is managed by relating the amount of maintained population's diversity to the stopping criterion and elapsed period of execution. Particularly, these methods reduce the importance given to the preservation of diversity as the end of the optimization is approached. This principle has been used to find new best-known solutions for the Frequency Assignment Problem, and to designing the winning strategy of the extended round of Google Hash Code 2020.

In 2019 the "Differential Evolution with Enhanced Diversity Maintenance" (DE-EDM) was proposed, which incorporates a diversity-aware replacement phase to DE. In particular this algorithm explicitly preserves diversity by altering a parameter dynamically. Hence, a dynamic balance between exploration and exploitation is attained with the aim of adapting the optimizer to the requirements of the different optimization stages. DE-EDM was validated with several test problems proposed in competitions of the IEEE Congress on Evolutionary Computation (CEC). In such a comparison, the top-ranked algorithms of each competition (CEC 2016 and CEC 2017), as well other diversity-based schemes were taken into account. The results showed that DE-EDM avoided premature convergence which improved remarkably to state-of-the-art algorithms. Although the benefits of explicitly promoting the diversity in DE are quite evident, those kind of strategies require the setting of two extra user-parameters. Those parameters are the initial distance factor (D_I) and the final moment for diversity promotion (D_F). While the former sets the initial level of diversity required by the replacement operator, the latter is the final moment where penalties based on diversity are performed.

We will present a novel diversity-aware strategy, which is called DE-EDM-II. DE-EDM-II is a simplification of DE-EDM in which the elite vectors are removed, just maintaining a multi-set of target and trial vector. This allows to show that even quite simple variants of diversity-aware DE excel on obtaining really promising

[1]Auto-tuning strategy for evolutionary algorithms: balancing between exploration and exploitation
[2]Exploration and exploitation in evolutionary algorithms: A survey

results. Additionally, we develop a more complete analysis with the aim of better understanding the impact of D_I and D_F on the performance, which shed some light on the reasons for the good performance of these kinds of algorithms in long-term executions.

Variable Decomposition for Large-scale Constrained Optimization Problems Using a Grouping Genetic Algorithm

Guadalupe Carmona-Arroyo, Marcela Quiroz-Castellanos, Efrén Mezura-Montes

Artificial Intelligence Research Center
Universidad Veracruzana
Sebastian Camacho 5, Centro, Xalapa, Veracruz, México
gcarmonaarroyo@gmail.com

Evolutionary Algorithms (EAs) have been used to solve an endless number of optimization problems. However, many times such algorithms are affected by the "curse of dimensionality", i.e., these search problems are more complex to solve when the number of decision variables increases. One of the best-known approaches to deal with large-scale optimization problems is the one proposed by Potter and De Jong called Cooperative Co-evolution (CC) [1], which is based on the divide-and-conquer strategy. The CC approach works in three stages; (1) first the problem is decomposed into subcomponents of less dimension and complexity, then (2) each subproblem is optimized separately, and finally, (3) the solutions of each subproblem cooperate to create the solution of the original problem.
Although many of the approaches to solve large-scale optimization problems have used CC, the first problem that arises is to find the adequate decomposition of the subgroups, since the interaction among the variables must be taken into account to divide the problem. In other words, if two or more variables interact with each other, they must remain in the same subcomponent just as the variables that do not interact with others must be part of an individual subcomponent. If the interacting variables are not grouped into the same subgroup, CC tends to find a solution that is not the minimum of the original problem but a local minimum introduced by incorrect problem decomposition [2].
Therefore, in this work, we propose a Grouping Genetic Algorithm (GGA) for variable decomposition in large-scale constrained optimization problems, since this type of algorithm has shown to have a very competitive performance in problems where the optimization of elements in groups is involved [3]. Our proposal is the first GGA approach to solve decomposition for large-scale problems. This involves a group-based representation, the operators used for the crossover and mutation have been chosen from among the operators for GGAs and the individuals evaluation is through the function proposed by Sayed et al. [4], which is based on the definition of separability of objective function and constraints.
This algorithm was evaluated on a set of 18 test functions proposed by Sayed et al. [4], which are problems with 1, 2, and 3 constraints with 100, 500, and 1000 variables. These 18 problems become an unconstrained problem to create only one variable decomposition.
Experimental results show that the new GGA obtains a suitable variable decomposition when compared against methods found in the specialized literature for variable decomposition, especially where the separation is more complicated, such as in problems with overlapping variables.

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Differential Evolution in Robust Optimization Over Time: Survival Time Approach

José-Yaír Guzmán-Gaspar[a], Efrén Mezura-Montes[a] and Saúl Domínguez-Isidro[b]

[a]Artificial Intelligence Research Center
University of Veracruz
Sebastián Camacho 5, Xalapa, Veracruz, MEXICO
yairguz@gmail.com, emezura@uv.mx

[b]National Laboratory on Advanced Informatics
Rebsamen 80, Xalapa, Veracruz, MEXICO
saul.dominguez@lania.edu.mx

1 Abstract

Optimization is an inherent process in various areas of study and everyday life. The search to improve processes, services, performances, etc., has originated different solution techniques. However, there are problems in which uncertainty is present over time, causing that the environment in which the solution will exist can change at a specific time. These types of problems are named Dynamic Optimization Problems (DOPs). Various studies have been carried out to resolve DOPs through tracking moving optima (TMO) [1][2][3], which cannot always be implemented due to different circumstances such as time or cost. The approach proposed in [4] tries to solve DOPs through a procedure known as robust optimization over time (ROOT). ROOT tries to solve DOPs by looking for a good solution for multiple environments and preserve it as long as possible, while its quality does not decrease from a pre-established threshold.
There are two approaches proposed in [5] to solve ROOT problems. The first one divides the problem into time windows and tries to find the best solution in each window by maximizing its Average Fitness. The second approach seeks a solution that can stay above a pre-established quality threshold as long as possible; this way of solving ROOT problems is called Survival Time. Differential Evolution (DE) is an evolutionary algorithm based on the difference of vectors designed to solve numerical problems. DE has been used to solve ROOT problems by using the Average Fitness approach obtaining competitive results [6] [7]. To the best of the authors' knowledge, there are no studies that determine the performance of DE in solving ROOT problems with the Survival Time approach, and this is where this work precisely focuses. This study analyses the standard DE (DE/rand/1/bin) by comparing its performance with three approximate methods (Mesh, Optimal, and Robust) proposed in [8]; whose results were significantly better than those obtained by state-of-the-art algorithms. This work introduces a comparison mechanism that allows the algorithm to discriminate similar solutions in terms of the fitness value and benefit the selection process. The experiments are carried out in the two benchmarks implemented in [8]. Furthermore, four dynamics of the problem environment (small-step, large-step, chaotic, and random) are included to analyze the algorithms' robustness. The results show that the standard ED holds a good performance to find ROOT solutions, improving the results reported in the state-of-the-art for the studied environments. Finally, the results show the robustness of the algorithm in most of the test instances.

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Optimization of the Design of a Website Using an Interactive Genetic Algorithm

Juan Gabriel Ruiz Ruiz and Salvador Enrique Lobato Larios

Computer Department
Universidad de la Sierra Juárez
Av. Universidad S/N. Ixtlán de Juárez, Oaxaca, México
jugaruiz@unsij.edu.mx, salvadorl@unsij.edu.mx

Abstract

Finding the best design for a website in visual and usability terms is the main objective of every designer. Some techniques used for this purpose are low, medium, and high-fidelity prototypes, which can be produced on paper or through software. The main characteristic of the first two is that they are cheap and are produced quickly. The disadvantage of these techniques is that when an extensive set of solutions is prototyped to find the most optimal design, the work becomes laborious. The aim of this work is to explore new methods to optimize the design of web pages using an interactive genetic algorithm.

Keywords: Optimization, Web Design, Usability, Interactive Genetic Algorithms.

OPTIMIZATION OF PHRASE SELECTION FOR A CONVERSATIONAL VIRTUAL AGENT THROUGH SPEECH ACTS AND OUTRANKING METHODS.

Xochitl Samantha Delgado-Hernandez[1]*, Maria Lucila Morales-Rodriguez[1], Nelson Rangel-Valdez[12], Laura Cruz-Reyes[1], Claudia Gomez-Santillan[1]

[1]Centro de Investigacion en Petroquimica
Instituto Tecnologico de Ciudad Madero - Tecnologico Nacional de Mexico
Prolongacion Bahia Adair, Blvd. de las Bahias, Parque Industrial Tecnia,
Altamira, Tamaulipas, 89603, Mexico
xsam.delgado@gmail.com, lucila.morales@itcm.edu.mx, nrangelva@conacyt.mx,
lauracruzreyes@itcm.edu.mx, claudia.gomez@itcm.edu.mx
[2]Catedras CONACyT â TECNM/Instituto Tecnologico de Ciudad Madero
*Corresponding author

Abstract

Currently, it is possible to hold a conversation between man and machine or conversational virtual agents (CVAs), using different methods to achieve this interaction, some better than others. However, to emulate human behavior, but there is still much to advance in this field. The objective of this work is the creation of a model that optimizes the response selection of a CVA. The proposed model uses speech acts to characterize the phrases of both the virtual agent and the user and outranking methods to select the best agent's response for given user interaction. The CVA is defined by a novel architecture that integrates a corpus of phrases, a deliberative process, and a personality model. The latter structure ensures that the virtual agent's responses have objectives and intentions closer to those of a real person than those provided by state-of-the-art chatbot.

Keywords: conversational virtual agents, speech acts, outranking

Acknowledgments

The authors want to thank the support from CONACYT projects 3058 Catedras CONACyT 2014, A1-S-11012 Ciencia Basica 2017-2018, and 312397 PAACTI 2020-1. Also thank the support from TecNM Project 5797.19-P, and from Laboratorio Nacional de Tecnologias de Informacion (LaNTI) del TecNM/Campus ITCM.

GENPO-SHARPE: STOCK SELECTION FOR INVESTING PORTFOLIO USING A GENETIC ALGORITHM WITH SHARPE RATIO APPLIED TO MEXICAN STOCK EXCHANGE

Juan Frausto Solís[a], **Juan J. González Barbosa**[a],
Guadalupe Castilla Valdéz[a*], **José L. Purata Aldaz**[a],
Diego Soto Monterrubio[a], **Leonor Hernández Ramírez**[a]

[a]División de Estudios de Postgrado e Investigación
TECNM/INSTITUTO TECNOLÓGICO DE CIUDAD MADERO
Av. 1º de Mayo esq. Sor Juana Ines de la Cruz s/n Col. Los Mangos C.P.89440
Cd. Madero Tamaulipas, México
* gpe_cas@yahoo.com.mx

The main objectives of any investment portfolio are to maximize the return and minimize the investment risk based on the diversification of financial assets. In this paper, we propose a new algorithm named GenPo-Sharpe (Genetic Portfolio Algorithm Based on Sharpe Ratio) for the selection of assets using the Sharpe Ratio (SR), the variance, and the correlation between assets. These criteria define the objective or fitness function of the GenPo-Sharpe, which seeks solutions. For the evaluation of this algorithm, we use a set of stocks from the Mexican Stock Exchange. The results show this algorithm surpassed the classical method based on the quadratic programming method and Markowitz formulation. We show that the proposed algorithm is much more straightforward than the classical method.
Keywords: Genetic Algorithm, Investment Portfolio, Asset Allocation, Sharpe Ratio, Markowitz model.

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The Bin Packing Optimization Problem: Algorithm Analysis and Open Problems

Jessica González-San Martín[a], Laura Cruz-Reyes[a], Bernabé Dorronsoro[b],

Marcela Quiroz-Castellanos[c], Claudia Gómez-Santillán[a], Nelson Rangel-Valdez[a],

Héctor Fraire[a]

[a] Division of Postgraduate Studies and Research
Instituto Tecnológico de Ciudad Madero
Av. 1o. de Mayo esq. Sor Juana Inés de la Cruz s/n Col.
Los Mangos, Cd. Madero, Tamulipas, México
jessica_san_martin@hotmail.com
cruzreyeslaura@gmail.com
rangel.nelson1980@gmail.com
cggs71@hotmail.com
hector.fraire2014@gmail.com

[b] Computer Science Engineering Department
University of Cadiz
Avenida de la Universidad, 10
11519 Puerto Real, Cadiz, Spain
bernabe.dorronsoro@uca.es

[c] Artificial Intelligence Research Center
Universidad Veracruzana
Calle Salvador Díaz Mirón 35, Zona Universitaria,
Xalapa-Enríquez, Veracruz, México.
maquiroz@uv.mx

The one-dimensional Bin Packing Problem (1D-BPP) is defined as a problem that consists of storing objects of different sizes, or weights, in the fewest number of fixed-size containers [1, 2]. It is a classic NP-hard combinatorial optimization problem and the most commonly used methods for its solution are through heuristic procedures that include intelligent strategies since the complexity of the 1D-BPP makes its solution computationally difficult through exact algorithms, for this reason it is considered intractable since it demands a large amount of resources for its exact solution [3]. The Bin Packing problem has been preserved as a current study problem due to the various applications that it offers; therefore, in the recent state of the art, there are different algorithms, mainly heuristic for solving the problem. For this work, those that reported the best results were selected as case studies.

General Arc-Flow Formulation with Graph Compression, present an exact method based on an arc-flow formulation with side constraints for solving bin packing and cutting stock problems, including multi-constraint variants, by merely representing all the patterns in a very compact graph [4]. Grouping Genetic Algorithm with Controlled Gene Transmission (GGA-CGT) is an intelligent packaging heuristic that simplifies and improves the packaging of objects, makes use of a rearrangement procedure that allows exploration and exploitation of the search space and a set of genetic grouping operators that promote the transmission of the best genes in chromosomes [2]. Consistent Neighborhood Search for one-dimensional Bin Packing (CNS_BP), present a consistent neighborhood search approach for solving the one-dimensional bin packing problem. The goal of this local search is to derive a feasible solution with a given number of bins, m, starting from m = UB-1, where UB is an upper bound obtained by using a variant of the classical

First Fit heuristic [5].
The most representative strategies were identified in the aforementioned algorithms, some of them are: a) Method to calculate various lower limits of the optimal solution and select the best one for each instance. b) Instance reduction method to simplify the problem. c) Method to control stagnation. These strategies are being implemented in one of the algorithms (GGA-CGT) to see their impact on performance in isolation and then together. Preliminary results of the new version of GGA-CGT showed an increment of its performance. It is expected that the GGA-CGT algorithm may have a greater impact on its performance when the selected strategies are completely implemented.
Tests were carried out on the GGA-CGT, General Arc-Flow Formulation and CNS_BP algorithms, which are considered the best state of the art algorithms for 1D-BPP. The tests were carried out for the 1615 instances of the literature and the 2800 new instances proposed by Quiroz in 2018 [6] who presents a new set of instances considered challenging that have not been addressed, since there is only one unpublished preliminary report. This is the first time that is analyzed the performance of those three state-of-the-art algorithms with instances of different complexity and size.
According to the experiments, it can be said that the CNS_BP algorithm obtained a better performance than GGA-CGT, both in instances resolved optimally (83% vs 78%) and in execution times (10% less). General Arc-Flow Formulation, being an exact algorithm, obtained the best results among the three evaluated algorithms, speaking of instances resolved optimally (86%), however, its execution times were the highest (1.7 times more than CNS_BP and 1.5 times more than GGA-CGT). It was observed that the instances of the BPP.5 and BPP.75 families that correspond to the new instances proposed by Quiroz [6] were the most challenging for the three algorithms. For analysis purposes, the most representative indicators were obtained (GAP, t and range) [2] and causally it was found that both families obtained a GAP value of 0 and an intermediate range. However, there are other instances that obtained a Gap of 0, such as triples. This tells us that this indicator (Gap) can serve as a guide to know the difficulty of an instance, however, it is not conclusive, and it is possible that there are other complementary factors that could indicate better this difficulty.
With this work, it was possible to identify some promising lines of research and works that could be addressed in the future: 1) Integration of construction processes [7] and destruction [5]. 2) Approximate solution of the mathematical model based on arc-flow formulation [4]. 3) Development of a hyper-heuristic to select between different metaheuristics [8, 9]. 4. Integration of different fitness functions. 5) Process of characterization of instances in the search process of metaheuristic algorithms.

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