

INTERNATIONAL STAFF WEEK



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DEVELOPMENT OF NEW TOOLS FOR OPTIMIZATION PROBLEMS IN NONLINEAR SPACES: APPLICATION TO FUZZY AND INTERVAL OPTIMIZATION PROBLEMS (NEWTOOP)

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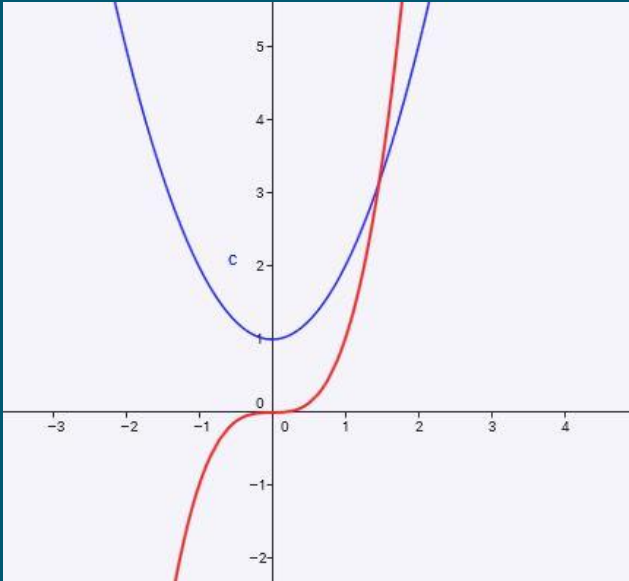


The aim:

- This project consists of finding new tools to solve problems that arise in disciplines such as Economics, Medicine, Physics or Engineering, which by their nature must be done with incomplete information or in non-Euclidean spaces (fuzzy environments, interval-valued and on Hadamard manifolds).
- We want to find what kind of functions in which the critical points, where the derivative cancels out, is a maximum or minimum.
- We study the convexity of functions to ensure that any local minimum is global and can be calculated with computational algorithms.

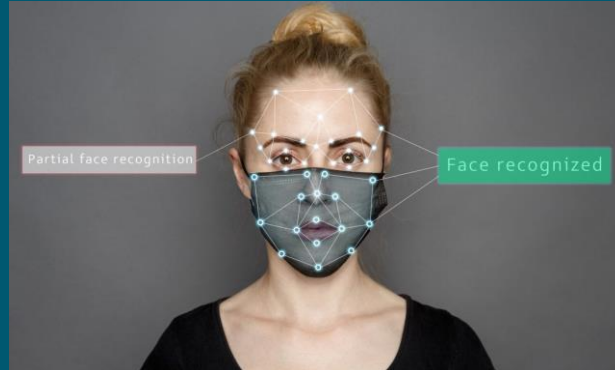
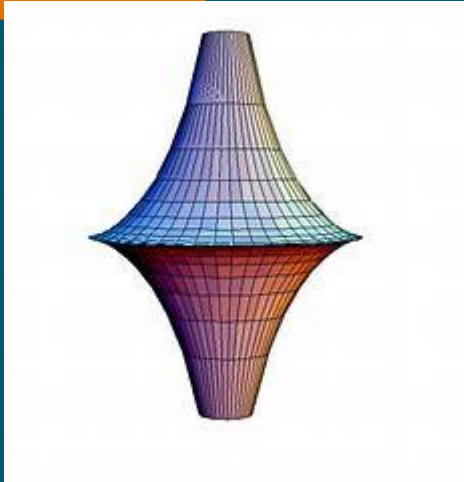
Lines of research:

- Hadamard Manifolds
- Fuzzy Theory



First line of research: Hadamard Manifolds

- *Manifolds* are nonlinear spaces where the minimum distance between two points is not a linear segment but a geodesic curve.
- *Applications:* Manifolds are using in computer vision to models sets of images, magnetic resonance image analysis, capture the shape of an object, for face recognition in the context still imagery, robotics,... Some banks offer the possibility to register via facial (selfie) or fingerprint recognition.
- *Mathematical advantages:* Solving the nonconvex constrained problem with the Euclidean metric is equivalent to solving the unconstrained convex minimization problem in the Hadamard manifold with the affine metric.



Second line of research: Fuzzy Theory

- *Fuzzy Theory* models ambiguous, vague or imprecise concepts on a scale between 0 and 1, between true and false, between black and white on a gray scale or intermediate values.
- *Applications:* The use of Fuzzy Theory is found in a multitude of small everyday household appliances (*eco-fuzzy technology*), such as washing machines that are able to self-regulate the amount of soap required for a wash depending on the degree of soiling of the clothes. Until now we could only program the washing machine with normal or half-load programmes. With eco-fuzzy technology, it is the machine itself that adjusts the amount of water required depending on the weight of the laundry to be washed. This saves water and energy.



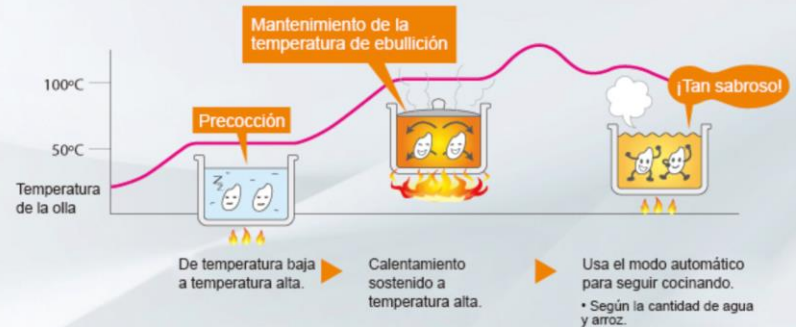
Second line of research: Fuzzy Theory

- *Applications: Logic Fuzzy technology* is used in rice cookers to microprocessor-control the cooking time and temperature according to the type of rice and water used.



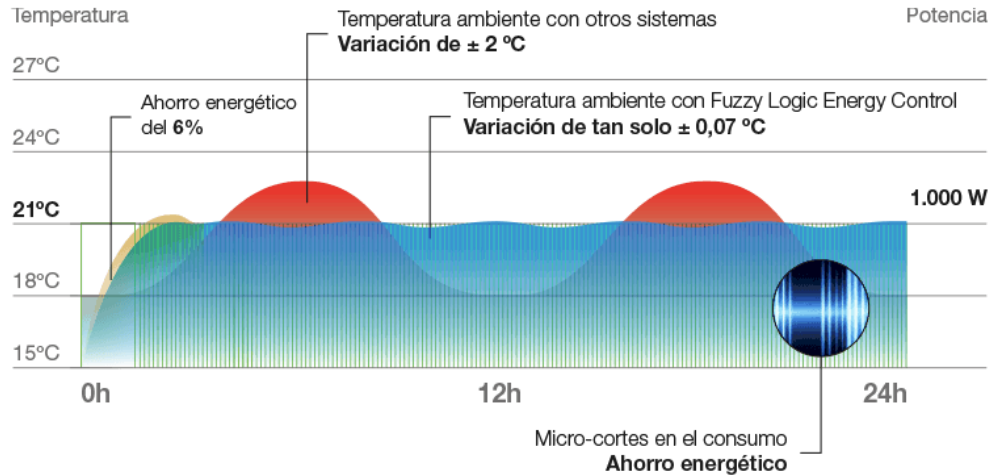
Tecnología avanzada Fuzzy Logic®

Ajusta la potencia y el tiempo de cocción automáticamente para un resultado preciso y uniforme cada vez.



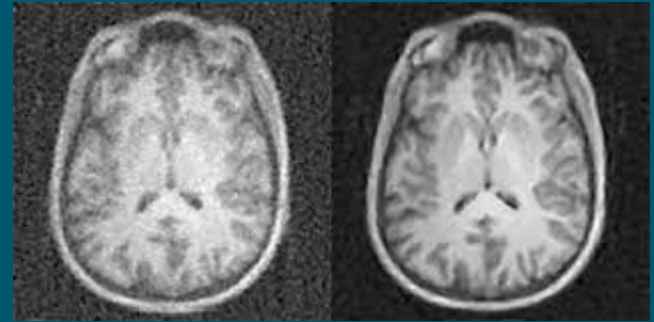
Second line of research: Fuzzy Theory

Applications: In refrigerators and air conditioners, too, the fuzzy system prevents fluctuations between over- and under-temperature. Control generates micro-cuts to keep the temperature stable with a thermal variation in the stationary period of only $\pm 0.07^\circ\text{C}$.



Second line of research: Fuzzy Theory

- *Applications:* It can also be found in image and sound sensors (image stabilization system (OIS) in cameras and video cameras in solving blurring images by hand shake), techniques to enhance the contrasts of an image by improving the perception of objects



Second line of research: Fuzzy Theory

- *Applications:* Can be localized a registration plate in an image and recognizes particular characters. The process can work any season, weather and day-time.



Second line of research: Fuzzy Theory

Applications: In medical technologies (automatic anaesthesia regulation). A fuzzy expert system to help the clinician discern the type of meniscal tear the patient has using magnetic resonance imaging.

When using the fuzzy logic controller design for ABS braking, the braking distance is shortened.

And artificial intelligence (intelligent traffic lights, autonomous driving vehicles, etc.). In Spain, the first driverless subway with fuzzy technology was built from Barajas airport's T4 terminal to Madrid.



Second line of research: Fuzzy Theory

- *Applications:* Fuzzy theory is used to automatically generate weather forecast texts for the municipalities based on data from the meteorological service of Galicia, MeteoGalicia (see Ramos et al. IEEE Transactions on Fuzzy Systems, 2015)

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METEOGALICIA

PREDICCIÓN | OBSERVACIÓN | MODELOS NUMÉRICOS | CALIDAD AIRE | FORMACIÓN Y METEOESCOLAS | PUBLICACIONES

Galicia | Ayuntamientos | Marítima | Puertos y cofradías | Mareas y lunas | Caminos | Cortes voz | Avisos | Orto y ocaso | Ultravioleta | Playas | Frío

Predicción para ayuntamientos

Ayuntamientos [Ayuda](#)

- A Coruña
- Ferrol
- Lugo
- Ourense
- Pontevedra
- ★ Santiago de Compostela
- Vigo

Buscar otro ayuntamiento:

Seleccione provincia:

A Coruña Lugo
 Ourense Pontevedra

Seleccione ayuntamiento de A Coruña:

Abegondo

Estaciones en el entorno de Santiago de Compostela

Predicción a corto plazo para Santiago de Compostela

	viernes, 20 de enero			sábado, 21 de enero			domingo, 22 de enero			lunes, 23 de enero		
	Mañana	Tarde	Noche	Mañana	Tarde	Noche	Mañana	Tarde	Noche	Mañana	Tarde	Noche
Estado del cielo												
POR HORAS												
Viento												
Ocurrencia lluvia	40%	80%	80%	40%	40%	10%	5%	5%	5%	5%	5%	5%
Temperatura(°C)	MIN MAX 10° 13°			MIN MAX 7° 13°			MIN MAX 2° 10°			MIN MAX 1° 10°		
UV Máximo	1			1			1			-		
Avisos Meteo	■			■			■			-		
Calidad aire	■			■			■			-		

Comentario

Se esperan cielos muy nubosos al principio, con nubes y claros hacia la mitad y poco nubosos o despejados al final del corto plazo. Tendremos precipitaciones el viernes. En cuanto a las temperaturas, serán normales para este periodo, con mínimas que descenderán notablemente y máximas que descenderán moderadamente.

En lo referido a la calidad del aire, se prevé que mejore de un grado adecuado a un grado bueno.



Conclusions and future work

- We have obtained new necessary and sufficient optimality conditions that characterize the generalized convex functions.
- We have proven that the results obtained for Euclidean spaces can be understood as particular cases of the results obtained in Hadamard manifolds.
- As future work, it would be interesting to study the possibility of extending these methods to make algorithms to obtain optimal points in Hadamard manifolds and similarly these results could also be extended to other fields such as physics or economics problems.



References

Ruiz-Garzón, G.; Osuna-Gómez, R.; Rufián-Lizana, A.; Hernández-Jiménez, B. (2020). Approximate efficient solutions of Vector Optimization Problem on Hadamard Manifolds via Vector Variational Inequalities. *Mathematics*. pp. 1-19. DOI.: 10.3390/math8122196 Percentil 92, Top 8%, Q1.

Osuna-Gómez, R.; Hernández-Jiménez, M. B.; Chalco-Cano, Y.; Ruiz-Garzón, G. (2020). New optimality conditions for multiobjective fuzzy programming problems. *Iranian Journal of Fuzzy Systems*. 17, pp. 19-31. Percentil 89, Top 11%, Q1.

Ruiz-Garzón, G.; Osuna-Gómez, R.; Rufián-Lizana, A.; Chalco-Cano, Y. (2019). The continuous-time problem with interval-valued functions: applications to economic equilibrium. *Optimization Methods & Software* 22 pp.1123-1144. DOI.: 10.1080/ 10556788.2018.1464569 Percentil 76, Top 24% Q1.



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