

# Evolutionary computation pioneer is distinguished professor at Tec



For [Carlos Coello](#), a **pioneer of evolutionary computation**, it all began in **1985** when his father gave him a present: a **Spectrum computer**, a kind of keyboard that connected to a television.

He fell in love with that little device. He spent hours playing games on it and programming. He copied already existing **code**, looked at the results, and broke each command down to understand what it did.

**His algorithms have been used** to design supersonic jets at **Stanford University**, to build an autonomous spacecraft in **Japan**, to optimize the sugar cane cutting process in **Cuba**, and to optimize electric power distribution networks in **Chile**.

In addition, he has received multiple international awards and was accepted as a member of **El Colegio Nacional**, the most important scientific and intellectual recognition in Mexico.

Today, he is part of **Tec de Monterrey's Faculty of Excellence** initiative, which seeks to bring together **100 international professors** to broaden students' learning experience.



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### **The first in an unexplored area**

Ever since Carlos Coello first used a computer, he knew he wanted to study computer science, but the options in his native **Chiapas** were few and far between. As a result, he studied **civil engineering** and then found his true love abroad.

He studied for a **Master's** and a **Ph.D.** in computer science at **Tulane University** in New Orleans, USA.

*"When I got there, they didn't give me much hope of surviving because my background wasn't at the same level of math and computer science as my peers, but I stayed."*

That was also where he **discovered what he is passionate about to this day**. He learned basic **evolutionary algorithms** and **neural networks** from a professor at Tulane.

Coello was fascinated by it because he had read an article about researchers who had used a **genetic algorithm** to **optimize a suit of armor**.

*"I thought the **genetic algorithm** thing was cool. I didn't know what it really was, but I thought I **could use it in optimization**,"* he recalls. That's what he did for the subject.

He continued along the same track in his Ph.D., but now specializing in **multi-objective optimization**, an area that had hardly been written about at all.

***“My 1996 thesis must’ve been the fifth in the history of this field. I was fortunate that it later became a very popular area, and that made me a pioneer in the area. A pioneer is not necessarily the person who does something best, but the one who does it first, and I was fortunate to be the first in many things,”*** he says.

## **Strange algorithms based on nature**

**Carlos Coello**, Distinguished Professor in **Computer Science** and **Computational Intelligence** at Tec de Monterrey’s [Faculty of Excellence](#), explains what **evolutionary multi-objective optimization** is:

*“They’re nature-inspired **solution-finding methods** that try to simulate the selection of the fittest. They are strange, random algorithms that can give a different result each time they are performed. Unlike traditional ones, they aren’t consigned to one path. They’re able to **look for different outcomes.**”*

And although strange, their main advantage is that they are very simple, very easy to implement. *“I always tell my students that evolutionary algorithms are easy to use. **The hard part is understanding how they work on a theoretical level.**”*

According to Coello, what made **multi-objective optimization** popular is that it is able to solve several objectives that are **in conflict with each other**.

*“At present, the only thing that has changed,”* he says, *“are the more complex problems that it solves.”*

***“I always tell my students that evolutionary algorithms are easy to use. The hard part is understanding how they work on a theoretical level.”***

For example, in **Stanford’s ultrasonic jet** design, the goal was to optimize aerodynamics, speed, and fuel consumption.

In other words, the algorithm allows the jet to reach the maximum possible speed while consuming the least amount of fuel with the use of an intelligent wing design.

Coello has also worked with the **Japan Aerospace Exploration Agency** to create some multi-objective techniques and algorithms to create a 1-kilogram spacecraft for photographing the surface of the **planet Mars**.

*“It was complicated because Mars has only 1% of Earth’s atmosphere. It meant **designing an airplane for a planet** that usually has no air.”*

In 2004, he was also involved in solving a problem with researchers at **NASA’s Jet Propulsion Laboratory (JPL)**.

They had sent a satellite to photograph the surface of Europa, one of **Jupiter’s** moons. The mission had already been completed, and they wanted to take advantage of the device to take pictures of the giant planet.

*“They wanted to change orbit, while making sure there was enough fuel to get back, so we **designed another algorithm that solved the problem**,”* he says.

His algorithms have also been used to improve the sugar cane cutting process in Cuba and to optimize **electric power distribution networks in Chile**.

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## **Coello at Tec de Monterrey’s Faculty of Excellence**

Carlos Coello has designed his life as if it were an **algorithm**. He has everything planned out well. Even the awards he has received are part of his goals, and he has achieved them on time, he says.

*“At this stage, I still want to achieve another **important contribution to computer science**. I can’t share right now what it is, but I’m already working on it,”* he says.

However, he does explain what his plans in the *Faculty of Excellence* will be: to reorient some scientific development plans, **to give master classes**, to give lectures, to publish research, and to receive projects.

In addition, he says that his age and experience mean he has the intellectual background to be a **first-rate science communicator**.

*“For me, it’s a **great pleasure to collaborate with the Tec**. It’s a huge opportunity to reach a wider audience and to try to share a bit of my passion and experience,”* he says.

According to Coello, **scientific research** is something that should not distinguish between public and private institutions, which is why he is sure that this collaboration will be a watershed moment for him.

*“I want to be one of the **educators of new generations of scientists** who are clear about the role of computer science within scientific disciplines and use it to create a better world,”* he concludes.

## **Awards for the Tec’s new distinguished professor**

- *National Award for Research in Exact Sciences from the Mexican Academy of Sciences in 2007.*
- *Medal for Scientific Merit from the Legislative Assembly of the Federal District in 2009.*
- *“Heberto Castillo Martínez” Ciudad Capital Award from the Government of the Federal District in 2011.*
- *Fellow at the Institute of Electrical and Electronics Engineers since 2011.*
- *National Award for Sciences and Arts in the area of Physical-Mathematical and Natural Sciences from the Department of Public Education in 2012.*
- *Scopus Prize in the field of computational engineering awarded by the publisher Elsevier in 2012.*
- *IEEE Kiyu Tomiyasu Award from the Institute of Electrical and Electronics Engineers in 2013.*
- *The World Academy of Sciences (TWAS) Award in “Engineering Sciences” in 2016.*

- *Luis Elizondo Award from Tecnológico de Monterrey in 2019.*

## **About the Tec's Faculty of Excellence initiative**

The [\*\*\*Faculty of Excellence\*\*\*](#) is a Tec de Monterrey initiative that seeks to bring together **100 international professors** to broaden students' learning experience and to promote international cooperation, innovation, diversity, and multidisciplinary research.

*"We're inviting them (the professors) to **inspire our faculty** and **our students** and to encourage them to **create an impact together**. I hope that in five or ten years we will look back and be proud of what has been done.*

*"Together, we are trying to **build the future** not just of the university but also of this **country** and of **Latin America**, to make an international impact," said **David Garza**, Rector and Executive President of the Tec.*

Its distinguished professors include **Raj Sisodia**, promoter of conscious and purposeful capitalism; **Marc J. Madou**, top expert in nanotechnology; Alejandro Echeverri, expert in architecture with social scale; and **Ana Mallet**, art curator, to name but a few.

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