

# Lauro Morales Montesinos

P h D . S c i e n c e



## A B O U T M E

*I consider myself a curious, skilled, and adaptable individual with extensive expertise in applied mathematics and science.*

I am interested in studying coherent structures that emerge from nonlinear models of continuous media. My recent work includes research on phase transitions in complex materials, the spectral and nonlinear stability of magnetic domains in ferromagnetic thin films, and the spectral stability of gas diffusion in glassy polymers

## C U R R E N T J O B

Postdoctoral position (CONAHCYT)

Advisor: Dr. Ramón G. Plaza Villegas

*IIMAS – UNAM 2022-2025*

Variational analysis and stability of coherent structures in continuum mechanics

Together with some IIMAS' colleagues, I am working in the following projects:

- (1) To determine the spectral stability of a traveling wave solution on a model for gas diffusion in a glassy polymer under convective perturbations by means of analytical and numerical methods.
- (2) To study the nonlinear stability of a martensite-martensite phase transition under plane wave perturbations using under-compressive shock stability theory and numerical computations.

Subject Instructor

*Science Faculty – UNAM 2024-2025*

Differential and Integral Calculus IV



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[Imm-ciencias.github.io](https://github.com/Imm-ciencias)



CDMX / México



## LANGUAGES

Native

Spanish

Conversational

English

## RESEARCH

## INTERESTS

Calculus of variations

Nonlinear stability theory

Partial Differential Equations

Analysis

Probability and Statistics

Data Science

## EDUCATION

PhD science (Mathematics)

Advisor: Antonio Capella Kort

*Mathematics Institute – UNAM 2016-2020*

Minimizing structures for elastic energy in phase transitions under the regime of linear geometric theory in thin film

Msc. Mathematics

Advisor: Antonio Capella Kort

*Mathematics Institute – UNAM 2014-2016*

Phase transitions in thin film geometric linear theory

Bsc. Physics

Advisor: Gilberto Flores Gallegos

*Mathematics Institute – UNAM 2005-2010*

Existence of annular vortices with boundaries close to internal Hill's spherical vortex streamlines

## TEACHING

Subject Instructor / Science Faculty – UNAM / 2019-2024

- *Differential and Integral Calculus I-IV*

Subject Instructor / ENP1 – UNAM / 2022-2023

- *Mathematics IV, V, VI areas 2 & 3*

On-line Instructor / Mathematics – UnADM / 2021-2022

- *Introduction to Mathematical thinking*
- *Statistics I*
- *Multivariable Calculus I*

Teacher Assistant / Science Faculty – UNAM / 2010-2017

- *Differential and Integral Calculus I-IV*
- *Complex Variable*
- *Fourier Analysis*
- *Stochastic Processes I y II*
- *Electromagnetism I*

## SOFTWARE



## AWARDS & DISTINCTIONS

2024-2028 CONAHCYT – *SNI* candidacy.

2022-2025 CONAHCYT – *Postdoctoral position by Mexico*.

2016-2020 CONACYT - *PhD Scholarship*.

2014-2016 CONACYT - *Master's Scholarship*.

2012-2013 CONACYT - *SNI 3 - Research assistant*.

## INDUSTRY EXPERIENCE

Estimation of water consumption in Mexico City  
ACCUBO-SACMEX-UNAM  
*March 2022 - August 2022*

Dr. Antonio Capella, Mat. Sergio Fernández, and myself developed predictive models of water consumption at different levels of aggregation at Mexico City. My main contributions were:

Model development & implementation:

- A Bayesian Gaussian mixture regressor to estimate meter's mechanical tear.
- Automative predictive variable selector based on different metrics (Variables used on predictive models).
- Classical and Bayesian regressors for per-capita consumption.

Developed software:

- Cleaning and coupling of databases from different public and private sources as Catastro & SACMEX databases.
- Address' splitting.
- Implementation, training and selection of regressors.
- Final-user webapp

## REFERENCIAS



Dr. Antonio Capella Kort



IMATE-UNAM



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Dr. Ramón G. Plaza Villegas



IIMAS-UNAM



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Dr. Luis Fernando López Ríos



IIMAS-UNAM



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## PUBLICATIONS

Capella, A., Melcher C., Morales, L. & Plaza R. *Stability of Moving Néel Walls in Ferromagnetic Thin Films*.

Preprint. (2024).

<https://arxiv.org/abs/2409.04023>

Capella, A., Melcher C., Morales, L. & Plaza R. *Nonlinear Stability of Static Néel Walls in Ferromagnetic Thin Films*.

Preprint (2024).

<https://arxiv.org/abs/2309.04432>

Capella, A., Morales, L. *On the Quasiconvex Hull for a Three-well Problem in Two-Dimensional Linear Elasticity*.

Calc. Var. 61, 100 (2022).

<https://doi.org/10.1007/s00526-022-02209-4>

Capella, A., Morales, L. *On the Symmetric Lamination Convex and Quasiconvex Hull for the Coplanar  $n$ -Well Problem in Two Dimensions*.

J Elast 148, 27–54 (2022).

<https://doi.org/10.1007/s10659-021-09878-w>

## TALKS

The symmetric quasiconvex and lamination convex hull for the coplanar  $n$ -well problem and its relation to pattern formation in thin-film shape memory alloys

UJED Durango "57th SMM National congress"

October -2024

Spectral and Nonlinear stability of Néel walls in ferromagnetic thin films

IMATE-UNAM "SEDNOL seminary"

April -2024

Nonlinear stability of coherent structures in PDEs (mini course).

CIMAT - Guanajuato

November -2023.

Nonlinear stability of magnetic Néel walls in thin film

IIMAS-UNAM Mexico city: "Applied Mathematics Colloquium"

September-2023.

Some Results on the Quasiconvex Hull for a n-well Problem in 2D Under Geometrically Linear Elastic Regime.

MPI - Leipzig Germany: "AG seminar Arbeitsgemeinschaft Applied Analysis"  
December-2019.

The Quasiconvex Hull for a Three-well problem in 2D under Geometrically Linear Elastic Regime.

CIMAT – Guanajuato: "12th Americas Conference on Differential Equations and Nonlinear Analysis"  
December – 2019.

Microstructure in alloys and the n-well problem in geometrically linear elasticity.

UAM-I Mexico City: "Mathematical Analysis Seminar"  
November – 2018.

## C O N G R E S S   A T T E N D A N C E

October 2024 – 57th National Congress SMM. UJED-Durango México.

September 2023 - Potential Theory Workshop: Intersections in Harmonic Analysis, Partial Differential Equations and Probability. CIMAT-Guanajuato México.

July 2023 – Annual Meeting SIAM Section Mexico: Building Bridges for Interdisciplinary Research. ITAM- Mexico City.

May 2021 - Integrative Think Tank on Environmental shock resilience in Mexico; data, models and policy. CIMAT-Guanajuato Mexico.

May 2019 - Workshop on differential equations and calculus of variations: The Monge-Ampere equation. CIMAT-Guanajuato Mexico.

March 2019 - Mathematical Models for Pattern Formations. CNA Pittsburgh PA.

December 2018 - Workshop on Multiscale Models: Theory and Applications. CIMAT-Guanajuato Mexico.

May 2018 - BUC13-GUQ2018: Workshop on Uncertainty Quantification. CIMAT-Guanajuato México.

September 2016 - CMO-BIRS 16w5021: Mathematical Problems of Orientationally Ordered Soft Solids. CMO-Oaxaca Mexico.

June 2016 - PIRE-CNA 2016 Summer School: New Frontiers in Nonlinear Analysis for Materials. CNA Pittsburgh PA.

October 2015 - IMA workshop: Mathematics and Mechanics in the 22nd Century: seven decades and counting... Eugene OR.

## P O S T E R S

Quasiconvex hull for three wells in 2D under Geometrically linear Elastic Regime.

*CNA Pittsburgh PA: "Mathematical Models for Pattern Formations"*

March-2019

Rigidity and non-Rigidity for Cubic-to-Tetragonal Phase Transition in GL Thin Film Theory.

*PIRE-CNA Pittsburgh PA: "2016 Summer School: New Frontiers in Nonlinear Analysis for Materials"*

June - 2016

Rigidity results for cubic-to-tetragonal phase transition in geometrically linear thin-film theory.

*IMA Eugene OR: "IMA workshop: Mathematics and Mechanics in the 22nd Century: seven decades and counting..."*

October-2015