BIOGRAPHICAL SKETCH

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NAME: Guinovart, David

eRA COMMONS USERNAME: DGUINOVART

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Universidad de La Habana (La Habana, Cuba)	BS	07/2013	Mathematics
Universidad de La Habana (La Habana, Cuba)	MS	12/2015	Mathematics
University of Central Florida (Orlando, FL, USA)	MS	05/2018	Applied mathematics
University of Central Florida (Orlando, FL, USA)	PHD	07/2021	Applied mathematics
University of Central Florida (Orlando, FL, USA)	Postdoctoral Fellow	07/2022	Modeling of Smart Materials Applications

A. Personal Statement

I am a mathematician with over ten years of experience developing and applying mathematical models to various problems in engineering and biomedicine. My research interests include composite materials, disease spread, epidemiology, and data science. I have experience in the mathematical modeling of composite materials using asymptotic homogenization and numerical methods (FEM). I have focused on elastic [1], piezoelectric, and flexoelectric [2] composite materials, studying their effective properties and applications. I have also worked on mathematical modeling of disease spread and epidemiology, using differential equations and dynamical systems. I have applied these models to understand the dynamics of infectious diseases, such as COVID-19, and to evaluate the impact of interventions, such as vaccination and social distancing [3]. Currently, I lead the Applied Mathematical, Computational, and Statistical Modeling laboratory at the Hormel Institute. Our laboratory is dedicated to developing and applying mathematical, statistical, and computational models that can address various problems in biomedicine, epidemiology, and engineering. We employ multiple methods, such as data science, deterministic models, machine learning, and biostatistics models, to model, predict, understand, and solve these problems. We also create software tools and virtual laboratories that allow the visualization and testing of hypotheses through mathematical models that are accessible and easy to use for non-experts in mathematics and computing techniques. In addition, our laboratory is committed to fostering a culture of interdisciplinary collaboration among various experts in biological science, engineering, mathematics, and computer science. We work closely with PIs from the Hormel Institutes, the University of Minnesota, and other scientific and educational institutions to address complex biological and engineering problems. Our laboratory aims to advance several branches of science by developing and applying novel models, software, and techniques that can handle large-scale and high-dimensional data.

[1] **Guinovart-Sanjuán, D**., Rodríguez-Ramos, R., Guinovart-Díaz, R., Bravo-Castillero, J., Sabina, F. J., Merodio, J., … Conci, A. (2016). Effective properties of regular elastic laminated shell composite. Composites. Part B, Engineering, 87, 12–20.
[2] **Guinovart-Sanjuán, D**., Vajravelu, K., Rodríguez-Ramos, R., Guinovart-Díaz, R., Bravo-Castillero, J., Lebon, F., … Merodio, J. (2020). Effective predictions of heterogeneous flexoelectric multilayered composite with generalized periodicity. International Journal of Mechanical Sciences, 181(105755), 105755.

[3] Guinovart Díaz, R., Abelló Ugalde, I., Morales Lezca, W., Bravo Castillero, J., Rodríguez Ramos, R., & **Guinovart Sanjuán, D.** (2020). Modelo SIR para el seguimiento de la COVID-19 en Cuba. Revista De Información Científica Para La Dirección En Salud. INFODIR, 0.

B. Positions, Scientific Appointments, and Honors

Positions and Employment

2023 -	Assistant Professor, Hormel Institute, University of Minnesota, MN, USA.
2022 - 2023	Assistant Professor, Department of Mathematics, University of Delaware, DE, USA.
2021 - 2022	Postdoctoral Fellow, Department of Mathematics, University of Central Florida, FL, USA
2016 - 2021	Ph.D. Student, Department of Mathematics, University of Central Florida, FL, USA
2015 - 2016	Adjunct professor, Departamento de Matemática, Universidad de La Habana, La Habana, Cuba
2013 - 2015	M.Sc. Student, Departamento de Matemática, Universidad de La Habana, La Habana, Cuba

Fellowships, Awards and Honors (selected)

2021	TROY MathFest 2021 scholarship. April. Troy University
2021	Student Scholar Symposium winner scholarship. UCF
2020	AIM Summer School on Dynamics, Data and the COVID 19 Pandemic, American Institute of Mathematics, San Jose, California.
2019	College of Sciences General Scholarship. UCF
2019	Yvette Kanouff Industrial Mathematics Scholarship. UCF
2018	Award Dr. Ed Norman Award for Excellence In Math, UCF
2016	Award of the Facultad de Matemática y Computación to the Distinguished Investigation Group, Universidad de La Habana

Other Experience and Professional Memberships

2020	Research Stay Universidad Autónoma de México, CDMX, Mexico, July
2020	Research Stay Universidad de La Habana, La Habana, Cuba, August
2015	Research Stay Aix-Marseille Université, Marseille, France, June
2018 -	Member, Society for Industrial and Applied Mathematics (SIAM)
2018 -	Member, American Mathematical Society (AMS)
2018-2020	Member, Math Alliance
2019-2020	Member, Math Association of America

C. Contributions to Science

1- Dynamical systems models to analyze disease propagation, cell proliferation, and dietary habits

Part of my research interest is the field of mathematical epidemiology, where I develop and apply mathematical models and dynamical systems to study the transmission and control of infectious diseases. My research interests include COVID-19, HIV, Dengue, and other emerging and re-emerging infections. I use analytical and computational methods to explore the effects of various factors, such as contact patterns, interventions, immunity, and evolution, on the dynamics and outcomes of epidemics. I aim to provide insights and guidance for public health decision-making and disease prevention. Some of my recent projects include modeling the impact of vaccination and social distancing on COVID-19 epidemics in different countries [4], analyzing the optimal allocation of antiretroviral therapy for HIV patients in resource-limited settings, and investigating the role of cross-immunity and vector control in Dengue transmission. I collaborate with experts from different disciplines, such as epidemiologists, biologists, statisticians, and clinicians, to ensure the relevance and validity of my models.

[4] **Guinovart-Sanjuán, D.**, Guinovart-Díaz, R., Vajravelu, K., Morales-Lezca, W., & Abelló-Ugalde, I. (2021). Multi-population analysis of the Cuban SARS-CoV-2 epidemic transmission before and during the vaccination process. Physics of Fluids (Woodbury, N.Y.: 1994), 33(10), 107107.

2- Mathematical and computational modeling of piezoelectric and flexoelectric composite materials

Piezoelectric and flexoelectric effects are essential for the design and optimization of composite materials that can harvest and store energy from mechanical sources. These effects are influenced by the microstructure of the composite, which consists of different phases with distinct properties, such as piezoelectric ceramics and non-piezoelectric polymers, and the geometrical structure (e.g., waviness, thickness variation, layers orientation), [5]. To understand and control these effects, one needs to develop a multiscale modeling and simulation framework that can capture the behavior of the composite at various length scales, from the macroscopic to the microscopic level. I have developed a novel multiscale approach to investigate piezoelectric [6] and flexoelectric [7] composite materials using homogenization and finite element methods and to compute the effective electromechanical properties. By relating the microstructure to the macroscopic performance and functionality of the composite, we aimed to improve its energy conversion efficiency and reliability. Properties such as piezoelectric and flexoelectric coefficients were linked to microscopic parameters such as phase volume fraction and orientation. Local electric potential and polarization distributions revealed possible electromechanical coupling mechanisms.

[5] **Guinovart-Sanjuán, D.**, Vajravelu, K., Rodríguez-Ramos, R., Guinovart-Díaz, R., Bravo-Castillero, J., Lebon, F., Merodio, J. (2020). Effective predictions of heterogeneous flexoelectric multilayered composite with generalized periodicity. International Journal of Mechanical Sciences, 181(105755).

[6] **Guinovart-Sanjuan, D.**, Rodríguez-Ramos, R., Vajravelu, K., Mohapatra, R., Guinovart-Díaz, R., Brito-Santana, H., … Sabina, F. J. (2022). Prediction of effective properties for multilayered laminated composite with delamination: A multiscale methodology proposal. Composite Structures, 297(115910), 115910.

[7] **Guinovart-Sanjuán, D.**, Mohapatra, R., Rodríguez-Ramos, R., Espinosa-Almeyda, Y., & Rodríguez-Bermúdez, P. (2023). Influence of nonlocal elasticity tensor and flexoelectricity in a rod: An asymptotic homogenization approach. International Journal of Engineering Science, 193(103960), 103960.

3- Mathematical and computational modeling of elastic composite materials

Elastic composite materials are widely used in engineering applications. The microstructure and the interactions between different phases, such as fibers and matrix, often influence these materials' mechanical properties (and failures). To design and optimize these materials, one needs to be able to model and simulate the behavior of the composite at different spatial scales, from the macroscopic to the microscopic level. This is a complex task, as it requires integrating and coupling multiple techniques. I have led a team to develop a novel multiscale approach to study elastic composite materials using homogenization and finite element methods. This approach combined data from three numerical methods: microstructure generation and characterization, homogenization theory, and finite element analysis, [10]. Understanding the effects of microstructure on the overall performance and failure of the composite is the first step toward improving its functionality and durability. This multiscale approach revealed insights at different spatial scales. Macroscopic properties such as stiffness and strength were related to microscopic parameters such as fiber volume fraction and orientation [11]. Local stress and strain distributions indicated potential damage initiation and propagation mechanisms. I also found that homogenization techniques provided accurate and efficient predictions of the composite's effective properties and reduced the simulations' computational cost.

[10] **Guinovart-Sanjuán, D.**, Rizzoni, R., Rodríguez-Ramos, R., Guinovart-Díaz, R., Bravo-Castillero, J., Alfonso-Rodríguez, R., … Sabina, F. J. (2017). Behavior of laminated shell composite with imperfect contact between the layers. Composite Structures, 176, 539–546.

[11] **Guinovart-Sanjuán, D.**, Rizzoni, R., Rodríguez-Ramos, R., Guinovart-Díaz, R., Bravo-Castillero, J., Alfonso-Rodríguez, R., … Sabina, F. J. (2018). Assessment of models and methods for pressurized spherical composites. Mathematics and Mechanics of Solids: MMS, 23(2), 136–147.