Ignacio Tomaš, Ph.D.
Department of Mathematics & Statistics,
Texas Tech University,
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EXPERIENCE

Assistant Professor (tenure-track) 08/2022 to present
Department of Mathematics & Statistics.
Texas Tech University.

Postdoctoral Appointee 01/2019 to 06/2022
Department of Computational Mathematics (Org. 01442).
Sandia National Laboratories (Albuquerque).
Advisor/s: John Shadid.

Visiting Assistant Professor 08/2015 to 12/2018
Department of Mathematics.
Texas A&M University, College Station.
Advisor/s: Jean-Luc Guermond, Bojan Popov.

Research Assistant 01/2011 to 07/2015
Department of Mathematics.
University of Maryland, College Park (UMCP).
Advisor/s: Ricardo H. Nochetto.

Research Assistant 03/2006 to 12/2008
Material Mechanics Division.
INTEMA (Science and Technology Materials Research Institute).
CONICET (National Research Council), Argentina.
Advisor/s: Adrián P. Cisilino.

EDUCATION/TRAINING

Ph.D. in Applied Mathematics 05/2012 to 05/2015
University of Maryland College Park (UMCP).
Thesis: *Ferrofluids: modeling, numerical analysis, and scientific computation.*
Advisor: Prof. Ricardo H. Nochetto.

M.Sc. in Applied Mathematics 08/2009 to 05/2012
University of Maryland, College Park (UMCP).
Advisor: Prof. Ricardo H. Nochetto.

Mechanical Engineer 03/2000 to 12/2005
Universidad Nacional de Mar del Plata (UNMdP), Argentina.

FUNDING

Ensuring a mathematically self-consistent plasma model hierarchy for high energy density plasma systems with complex equations of state. Funding entity: Laboratory Directed Research & Development program, Sandia National Laboratories. Period: August 2024 - August 2028, Total award: $150,000.

Travel Support for Mathematicians. Funding entity: Simons Foundation. Period: August 2024 - August 2028, Total award: $42,000.

Hydrodynamic models of electric charge transport: structure-preserving numerical methods (PI). Funding entity: NSF, Computational Mathematics program. Award Abstract # 2409841. Period: August 2024 - August 2027. Total award: $219,782. **NSF Award Link**.

Asymptotic preserving methods for electron-fluid models in the large-magnetic-field-limit with mathematically guaranteed properties (PI). Funding entity: Laboratory Directed Research & Development

program, Sandia National Laboratories. Project #226834. Period: January 2022 - July 2022, Total award: $115,000, **Final report**.

Fluid models of charged species transport: numerical methods with mathematically guaranteed properties (PI). Funding entity: Laboratory Directed Research & Development, Sandia National Laboratories program. Project #223796. Period: February 2021. Total award $115,000. **Final report**.

RESEARCH INTERESTS/PROGRAM

Broad interests in the Analysis and development of space and time discretizations for Partial Differential Equations (PDEs) with mathematically provable properties. More precisely: development of numerical methods that preserve essential structural properties of the PDE. In particular: energy estimates, entropy inequalities, invariant sets, maximum/minimum principles, positivity properties, and asymptotic limits of the original PDE. My core interest lies in PDEs that preserve two or more of such notions of stability, in particular, when "Hilbert-space like" notions of stability are either non-applicable or unimportant. PDE physical modeling: particular interest on electric charge transport modeling (from semi-conductor to gas-plasma), electron dynamics, and electromagnetism-matter interaction within the context of Continuum Physics.

SCIENTIFIC SKILLS/TECHNICAL COMPETENCES

Extensive knowledge in the fields of Numerical Analysis of PDEs, Scientific Computation and Physical Modeling: continuous and discontinuous Finite Element Methods for Elliptic, Parabolic and Hyperbolic PDEs, Incompressible Navier-Stokes Equations, Phase-Field Methods, Gradient-Flows, Hyperbolic Conservation Laws, FCT limitation and related maximum principle and/or invariant-set preserving techniques, Mixed Formulations, Continuum Physics, Electric charge transport modeling and physics, Electromagnetism, PDE modeling, Preconditioning techniques, Parallel Computing.

PROGRAMMING/SOFTWARE SKILLS

C++ (advanced), STL, Boost, Fortran, Linux shell, Trilinos tool-chain (working knowledge), CMAKE (working knowledge), svn, git, Visit, Paraview, Matlab, Windows, DOS, LaTeX, CAD, HTML.

PUBLICATIONS: SELECTED

[1] M. Maier, M. Kronbichler and I. Tomas, *Graph-based methods for hyperbolic systems of conservation laws using discontinuous space discretizations*, Submitted to SIAM-SISC, 2024, [**arXiv**].

[2] J-L Guermond, M. Maier, B. Popov, L. Saavedra, I. Tomas, *Greedy invariant-domain preserving approximation for hyperbolic systems, 2023, Submitted Journal of Scientific Computing (JOMP)* [**arXiv**]

[3] M. Nazarov, Tuan Dao and I. Tomas, *Structure preserving numerical methods for the ideal compressible MHD system*, Submitted to Journal of Computational Physics, 2023, [**arXiv**]

[4] A. Salgado and I. Tomas, *Diagonally implicit Runge-Kutta schemes: Discrete energy-balance laws and compactness properties*, Journal of Numerical Mathematics, 2023, [**arXiv**, **Journal**]

[5] M. Maier, J. Shadid, and I. Tomas, *Structure-preserving finite-element schemes for the Euler-Poisson equations*, Communications in Computational Physics, 2023, [**arXiv**, **Journal**]

[6] Y. Lin, J. Chan, I. Tomas, *A positivity preserving strategy for entropy stable discontinuous Galerkin discretizations of the compressible Euler and Navier-Stokes equations*, Journal of Computational Physics, 2023, [**arXiv**, **Journal**]

[7] J-L Guermond, M. Kronbichler, M. Maier, B. Popov, I. Tomas, *On the implementation of a robust and efficient finite element-based parallel solver for the compressible Navier-Stokes equations*, Journal of Computational Physics, [**arXiv**, **Journal**].

[8] R. G. Patel, I. Manickam, N. A. Trask, M. A. Wood, M. Lee, I. Tomas, Eric C. Cyr, *Thermodynamically consistent physics-informed neural networks for hyperbolic systems*, Journal of Computational Physics, [**arXiv**, **Journal**].

[9] J-L. Guermond, M. Maier, B. Popov, and I. Tomas, *Second-order invariant domain preserving approximation of the compressible Navier-Stokes equations*, CMAME, Volume 375, March 2021, [**arXiv**, **Journal**].

[10] D. Arndt, W. Bangerth, B. Blais, T. Clevenger, M. Fehling, A. V. Grayver, T. Heister, L. Heltai, M. Kronbichler, M. Maier, P. Munch, J-P Pelteret, R. Rastak, I. Tomas, B. Turcksin, Z. Wang, D. Wells, *The deal.II Library, Version 9.2*, Journal of Numerical Mathematics, July 2020, [**Preprint**] .

[11] H. Hajduk, D. Kuzmin, T. Kolev, V. Tomov, I. Tomas, J. Shadid, *Matrix-free subcell residual distribution for Bernstein finite elements: Monolithic limiting*, Computers & Fluids, Volume 200, 30 March 2020, July 2020, [**Journal**].

[12] J-L. Guermond, B. Popov, and I. Tomas, *Invariant domain preserving discretization-independent schemes and convex limiting for hyperbolic systems*, CMAME, [**arXiv**], [**Journal**].

[13] J-L. Guermond, C. Klingenberg, B. Popov, and I. Tomas, *The Suliciu approximate riemann solver is not invariant domain preserving*, Journal of Hyperbolic Differential Equations, 2019, [**Journal**].

[14] J-L. Guermond, M. Nazarov, B. Popov, and I. Tomas, *Second-order invariant domain preserving approximation of the Euler equations using convex limiting*, SIAM SISC, [arXiv], [Journal].
[15] F. Bouillault, L. Cappanera, J-L. Guermond, X. Mininger, C. Nore, I. Tomas, and R. Zanella, *Study of Magnetoconvection Impact on a Coil Cooling by Ferrofluid with a Spectral/Finite Element Method* , CompuMag IEEE, 2017, [Journal].
[16] R.H. Nochetto, A.J. Salgado, and I. Tomas, *A diffuse interface model for two-phase ferrofluid flows*, 2016, CMAME, [arXiv], [Journal].
[17] R.H. Nochetto, A.J. Salgado, and I. Tomas, *The equations of ferrohydrodynamics: modeling issues and numerical methods*, 2016, M3AS, [arXiv], [Journal].
[18] R.H. Nochetto, A.J. Salgado, and I. Tomas, *A semi-implicit fully discrete scheme for the micro-polar Navier-Stokes equations*, (2014), M3AS Math. Model. Meths. Appl. [arXiv], [Journal]

PRESENTATIONS

SIAM TX-LA 2023. University of Louisiana at Lafayette.	November 2023
USNCCM 2023. Albuquerque (keynote speaker)	July 2023
Finite element Rodeo 2023. Texas A&M University	March 2023
University of Tennessee Knoxville. Dept. Mathematics.	November 2021
Texas Tech University. Dept. Mathematics.	August 2021
Oak Ridge National Laboratory. Multiscale Methods Group.	August 2021
United States Naval Research Laboratory (NRL).	March 2021
University of New Mexico. Appl. Math. Seminar.	October 2019
Multimat 2019. Trento, Italy.	September 2019
SIAM CSE. Spokane, Washington.	March 2019
Sandia National Laboratories. Albuquerque, New Mexico.	July 2018
HYP2018. University Park, Pennsylvania.	June 2018
SIAM CSE. Atlanta, Georgia.	March 2017
Texas A&M University. Finite Element Rodeo.	March 2016
Courant Institute, NYU. Appl. Math. Lab. Seminar.	November 2014
Texas A&M University. Numerical Analysis Seminar.	October 2014
Carnegie Mellon University. CNA Seminar.	October 2014
SIAM Annual Meeting. Chicago.	July 2014
Brown University. Scientific Computing Seminar.	November 2013

TEACHING

MATH 5345. Numerical Analysis of PDEs, Part I	Spring 2024
MATH 2450. Calculus III, Instructor, TTU.	Fall 2023
MATH 3350. Higher Mathematics for Engineers and Scientists I, Instructor, TTU.	Spring 2022
MATH 3350. Higher Mathematics for Engineers and Scientists I, Instructor, TTU.	Fall 2022
MATH152. Engineering Mathematics II, Instructor, TAMU.	Fall 2018
MATH308. Ordinary differential equations, Instructor, TAMU.	Spring 2018
MATH147. Calculus I for Biological Sciences, Instructor, TAMU.	Fall 2017
MATH308. Ordinary differential equations, Instructor, TAMU.	Spring 2017
MATH151. Calculus for engineering majors, Instructor, TAMU.	Fall 2016
MATH151. Calculus for engineering majors, Instructor, TAMU.	Spring 2016
MATH151. Calculus for engineering majors, Instructor, TAMU.	Fall 2015
MATH130. Calculus I for the Life Sciences, T.A., UMCP.	Fall 2012
MATH140. Calculus I, T.A., UMCP.	Fall 2010
MATH220. Elementary Calculus I, T.A., UMCP.	Spring 2010
MATH111. Introduction to Probability, T.A., UMCP.	Fall 2009
Solid Dynamics. TA, Engineering Department, UNMdP.	Fall 2008

ACADEMIC SERVICE

I have been the organizer of the Applied Mathematics seminar at Texas Tech University a few times. I try to foster a diverse portfolio of speakers ranging from Analysis of PDEs, Numerical Analysis, Information Theory, Engineering applications, and even Experimental Physics. See for instance:

`https://www.math.ttu.edu/events/seminars/applied_math/2023/spring/`
`https://www.math.ttu.edu/events/seminars/applied_math/2023/fall/`

https://www.math.ttu.edu/events/seminars/applied_math/2024/spring/
https://www.math.ttu.edu/events/seminars/applied_math/2024/fall/

Another aspect of academic life is the participation in peer review processes. I referee papers for Journal of Computational Physics (quite frequently), Journal of Scientific Computing, Journal of Mathematical Analysis and Applications, SINUM, Journal of Computational and Applied Mathematics, and IMA Journal of Numerical Analysis among others.