Manuel A. **Díaz**

PH.D. IN APPLIED MECHANICS · CFD SOLVERS DEVELOPER · GPU PROGRAMMER · AI HOBBYIST

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Summary

Senior Research Engineer with 10+ years of experience developing high-performance GPU-accelerated algorithms and solvers for computational fluid dynamics (CFD) and aeroacoustics (CAA). Proven track record delivering 100× performance improvements through parallel computing, multi-GPU architectures, and optimization of scientific computing codes. Expertise spans NVIDIA CUDA, AMD HIP/ROCm, MPI, and modern C++17, with contributions to open-source projects and peer-reviewed publications in top-tier journals.

Work Experience

Centre de recherche en aéronautique (Cenaero) ASBL

Gosselies, Belgium

SENIOR RESEARCH ENGINEER, CDI — *Oct. 2022 - Currently*

Numerical engineer collaborating on industry-related projects:

- Phase III of WINGS (24 month): Collaborated to port and optimize Cenaero's `Fidelio` (C++17 code) to NVIDIA and AMD GPUs, achieving 4.5× and 2.5× speedups, respectively, over the MPI implementation on a 128-thread AMD EPYC Zen 3 Milan CPU node. Showed that the ported code, running on a single A100 GPU, matched the performance of 4.5 CPU nodes in LUCIA supercomputer.
- MAISOVI (6 month): Developed a Finite-Volume Lattice-Boltzmann (FV-LB) solver to model rarefied gases. Noiseless results were produced in contrast to DSMC simulations.
- Virtual-Lab (6 month): Performed an assessment of Material Point Methods (MPM). Using GPU-accelerated in-house code, simulated solid-fluid interaction problems involving large deformations with 10× speedups over CPU-node implementations.
- Tools: C++17, CUDA, HIP/ROCm, CMake, Python3, valgrind, NSight Compute, LaTeX, LUCIA & LUMI supercomputers.

Université de Poitiers (UP) | Institute Pprime

Poitiers, France

POSTDOCTORAL RESEARCH FELLOW, ANR PROJECT, CDD — *Jan. 2022 - Sep. 2022*

Numerical researcher working on time-reversal aeroacoustics:

- Collaborated to project MegaMicros phase III: Investigated wave packet techniques along an in-house time-reversal solver.
- Tools: C/C++17, OpenMPI, Matlab, Python3, Scikit, LaTeX, PARADIGM code, Thor supercomputer.
- Results: Numerical results indicated that time reversal with reflective objects is more complex than initially expected.

École Nationale Supérieure de Mécanique et d'Aérotechnique (ENSMA) | Institute Pprime

Poitiers, France

POSTDOCTORAL RESEARCH FELLOW, FEDER PROJECT, CDD — *Sep. 2020 - Dec. 2021*

Numerical researcher working on computational fluid mechanics.

- Contributed to compressible Navier-Stokes branch of Xcompact3d and
  - Developed a high-order formulation of Immersed Boundary Method (IBM) for complex and moving geometries,
  - Investigated stable formulations of Dirichlet boundary conditions constructed with PINNs.
- Tools: Fortran, OpenMPI, 2decomp-fft Library, Matlab, Windows-WSL, LaTeX Thor supercomputer.
- Results: a conference paper was presented at Congrès Français d'Acoustique. Results were used to formulate a Ph.D. student thesis proposal.

Institute Jean Le Rond d'Alembert | Sorbonne Université

Paris, France

POSTDOCTORAL RESEARCHER, ANR PROJECT, CDD — *Mar. 2019 - Aug. 2020*

- Contributed to a novel DGFEM solver for modeling acoustic Solid-fluid Interactions on inertial frame of reference: PARADIGM code
- Developed the initial MPI/C++17 version of a coupled DG solver for *Linearized Euler Equations* and the *Elastic Wave Equations*.
- Investigated the use of a 4DEnVar *Data assimilation* and *Time-reversal* techniques for reconstructing acoustic sources.
- Tools: C/C++17, STL library, Python3, LaTeX, D'Alembert's Linux Cluster
- Results: a paper was accepted at Journal of Sound and Vibration, two conference papers were presented at Forum Acusticum.

Institute of Biomedical Engineering and Nanomedicine (NHRI)

Zhunan, Taiwan

POSTDOCTORAL RESEARCH FELLOW, NSC PROJECT, CDD — *Dec. 2015 - Dec. 2018*

- Studied and formulated novel model equations in nonlinear acoustics suitable for parallel computations.
- Designed and implemented a multi-GPU WENO solver for strongly nonlinear acoustic simulations, delivering a 100× performance improvement compared to the original single-threaded CPU code.
- Tools: C/CUDA, OpenMPI, OpenMP, nvprof, LaTeX, Internal multi-GPU Linux cluster based on Tesla K80.
- Results: Two papers were submitted and accepted at Journal of Computational Physics and Computer & Fluids.

Formation

National Taiwan University (NTU)

Taipei, Taiwan

PH.D. IN APPLIED MECHANICS (BAC+8), GPA: 3.85/4.3 — *Feb. 2012 - Dec. 2015*

- Thesis: "*Modeling Rarefied Gas Flows of Arbitrary Statistics with the Semiclassical Boltzmann-BGK equation*"

National Taiwan University (NTU) — *Taipei, Taiwan*

Master in Applied Mechanics, GPA: 3.93/4.3 — *Sep. 2010 - Jan. 2012*

- Qualified for direct-doctorate program on February 10th, 2012

Universidad Centroamericana JSC (UCA) — *San Salvador, El Salvador*

B.Sc. in Mech. Engineering (BAC+5), GPA 8.23/10 — *Feb. 2003 - Aug. 2008*

- Thesis: "*Design of a Cross-flow Turbine*"

Skills

Communication skills	Espagnol (Native), Anglais (C2), Chinois (B1), Français (A2).
Proficient in Computer Languages	Python 3, Matlab, Mathematica, C/C++, Fortran, CMake, LaTeX, Git, Bash.
Libraries & APIs	CUDA, HIP/ROCm, MPI, MPIIO, HDF5, OpenMP.
IDE Tools	Visual Studio Code, Vim, Jupyter.

Work Interests

- Mathematical modeling of transport phenomena using:
  - Computational fluid dynamics (CFD) & Computational Aeroacoustics (CAA),
- Developing high-performance numerical algorithms for:
  - NVidia and AMD graphical processing units (GPUs),
  - Multi-GPU and heterogeneous architectures,
- Simulation of GPU accelerator architectures using gem5 for:
  - Performance analysis and optimization of GPU architectures,
  - Model Bandwidth and Latency of GPU architectures,
  - Model cache size usage and miss rate.
- Data computation and visualization Taichi Lang.

Personal References

- Thibaut VAN HOOF, `thibaut.vanhoof@cenaero.be`
- Vincent VALEAU, `vincent.valeau@univ-poitiers.fr`
- David MARX, `david.marx@univ-poitiers.fr`
- Régis MARCHIANO, `regis.marchiano@sorbonne-universite.fr`
- J.C. CHASSAING, `jean-camille.chassaing@sorbonne-universite.fr`
- Maxim SOLOVCHUK, `solovchuk@nhri.org.tw`
- Jaw-Yen YANG, *Ph.D. director*, `yangjy@iam.ntu.edu.tw`
- Yi-Ju CHOU, *Ph.D. co-director*, `yjchou@iam.ntu.edu.tw`

Selected Presentations

- M. D. Escobar, R. Marchiano et J.-C. Chassaing, "Identification of Aeroacoustics Sources with Data Assimilation", in Forum Acusticum, 2020, p. 1535-1535. https://hal.science/hal-03215254.
- Y. Zhou, M. D. Escobar, R. Marchiano, D. Marx, C. Prax et V. Valeau, "Aeroacoustic Source Identification with Effects of Solid Boundaries Using a Numerical Time-reversal Technique", in Forum Acusticum, 2020, p. 741-745. https://hal.science/hal-03229452
- M. A. Diaz, V. Fortuné, D. Marx et C. Prax, "A High-Order Immersed Boundary Technique for Computational Aeroacoustics", Congrès Français d'Acoustique, 2022. https://hal.science/hal-03848118v1

Selected Publications

Peer-reviewed journal articles:

- M. A. Diaz et J.-Y. Yang, "An Efficient Direct Solver for Rarefied Gas Flows with Arbitrary Statistics," Journal of Computational Physics, t. 305, p. 127-149, 2016. doi : https://doi.org/10.1016/j.jcp.2015.09.003.
- M. A. Diaz, M. A. Solovchuk et T. W. Sheu, "High-performance multi-GPU solver for describing nonlinear acoustic waves in homogeneous thermoviscous media," Computers & Fluids, t. 173, p. 195-205, 2018, issn : 0045-7930. doi : https://doi.org/10.1016/j.compfluid.2018.03.008.
- Y. Zhou, M. A. Diaz, R. Marchiano, D. Marx, C. Prax et V. Valeau, "Localizing aeroacoustic sources in complex geometries: A hybrid method coupling 3D microphone array and time-reversal," Journal of Sound and Vibration, 2024, 584, 118452. doi : https://doi.org/10.1016/j.jsv.2024.118452.