

# Fabio Vito Difonzo

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## CURRICULUM VITÆ

### *Work*

Dept. of Mathematics  
Università degli Studi di Bari Aldo Moro

### CURRENT POSITION

**December 2020 – December 2023 - Assistant Professor, Department of Mathematics, University of Bari, Italy.**

Activities:

- research in Numerical Analysis and Applied Mathematics;
- teaching first year math classes.

**September 2019 – December 2020 - Assistant Professor (part-time), Department of Computer Science, Faculty of Electrical Engineering, Czech Technical University in Prague, Prague, Czech Republic.**

Activities:

- research for Research Center for Informatics (RCI, CTU in Prague) on: traffic models, optimization on graphs;
- bachelor and diploma thesis supervising.

**June 2016 – December 2020 - Data scientist, Code Architects Automation Srl, Santeramo in Colle (BA), Italy.**

Activities:

- machine learning algorithm development (scikit-learn, OpenCV): image processing, pattern recognition, text detection, pose detection, data analysis;
- optimal control, path, trajectory and maneuvering planning for industrial AGVs in hybrid environments;
- mathematical modeling of optimization problems for real world applications and relative solution development;
- software development using Matlab, Python;
- Agile methodologies (Scrum technology).

## **EDUCATION**

**January 2011 – December 2015 - Ph.D. in Mathematics, Georgia Institute of Technology (USA)**

GPA: 3.88/4. Major in Mathematics, minor in Control Theory. Thesis title: *The Filippov Moments Solution on the Intersection of Two and Three Manifolds*. Supervisor: Prof. Luca Dieci (Georgia Institute of Technology, USA).

**August 2013 – August 2014 - M.Sc. in Aerospace Engineering, Georgia Institute of Technology (USA)**

GPA: 3.88/4. Supervisor: Prof. Wassim M. Haddad (Georgia Institute of Technology, USA).

**September 2007 – October 2009 - Laurea Specialistica (equivalent to M.Sc.) in Mathematics, University of Bari (Italy)**

Degree certificate taken on October 8, 2009 with a score of 110/110 cum laude, defending the thesis in Numerical Analysis *Modelli per la previsione del rischio di credito (Credit Risk Forecast Models)*, supervisor: Prof. Luciano Galeone (University of Bari, Italy).

**September 2004 – October 2007 - Laurea triennale (equivalent to B.Sc.) in Mathematics, University of Bari (Italy)**

Degree certificate taken on October 4, 2007 with a score of 110/110 cum laude, defending the thesis in Mathematical Analysis *Aspetti Metrici e Topologici della Teoria dei Punti Fissi (Metric and Topological Aspects of Fixed Point Theory)*, supervisor: Prof. Francesco Altomare (University of Bari, Italy).

## **TEACHING ACTIVITIES**

### **Instructor:**

- Spring 2014: Lead TA (Graduate Student Instructor) for *MATH 2401 Calculus III*, Georgia Institute of Technology, Atlanta, GA (USA);
- Fall 2014: Graduate Student Instructor for *MATH 1502 Calculus II*, Georgia Institute of Technology, Atlanta, GA (USA);
- Spring 2015: Graduate Student Instructor for *MATH 1502 Calculus II*, Georgia Institute of Technology, Atlanta, GA (USA);
- Fall 2015: Graduate Student Instructor for *MATH 1552 Integral Calculus*, Georgia Institute of Technology, Atlanta, GA (USA);
- II Semester 2021: instructor for *Numerical Analysis*, University of Bari, Italy.

### **Teaching Assistant:**

- Fall 2011: TA for *MATH 2403 Differential Equations*, Georgia Institute of Technology, Atlanta, GA (USA);
- Spring 2012: TA for *MATH 2401 Calculus III*, Georgia Institute of Technology, Atlanta, GA (USA);
- Fall 2012: TA for *MATH 2401 Calculus III*, Georgia Institute of Technology, Atlanta, GA (USA);
- Spring 2013: TA for *MATH 2401 Calculus III*, Georgia Institute of Technology, Atlanta, GA (USA);

- Fall 2013: TA for *MATH 2401 Calculus III*, Georgia Institute of Technology, Atlanta, GA (USA);

#### **Grader:**

- Spring 2011: grader for *MATH 4317 Analysis I*, Georgia Institute of Technology, Atlanta, GA (USA);
- Fall 2012: grader for *MATH 6112 Advanced Linear Algebra*, Georgia Institute of Technology, Atlanta, GA (USA);
- Spring 2014: grader for *MATH 4305 Topics in Linear Algebra*, Georgia Institute of Technology, Atlanta, GA (USA);
- Fall 2014: grader for *MATH 6112 Advanced Linear Algebra*, Georgia Institute of Technology, Atlanta, GA (USA);
- Fall 2015: grader for *MATH 6112 Advanced Linear Algebra*, Georgia Institute of Technology, Atlanta, GA (USA)

#### **Undergraduate students supervised:**

- Ilaria Bavaro (co-supervised with Prof. Nicoletta Del Buono), M.Sc. in Mathematics, University of Bari (Italy), December 2017. Thesis title: “Algoritmi numerici per la soluzione di problemi di allocazione ottima di un magazzino (Numerical algorithms for solving optimal warehouse allocation problems) ”

#### **SERVICES**

- May 2013–May 2015: President of the SIAM Student Chapter at Georgia Institute of Technology, Atlanta, GA (USA);
- organizer of the second “Southeast SIAM Student Conference”, Georgia Institute of Technology, Atlanta, GA (USA), April 11<sup>th</sup>, 2015.

#### **PRESENTATIONS & CONFERENCES**

- June 27–July 2, 2011: Current challenges in stability issues for numerical differential equations, *CIME-EMS Summer School in applied mathematics*, Cetraro (Italy).
- June 12–15, 2012: “On the construction of a Filippov sliding vector field on a co-dimension 2 singularity surface” (20 minutes talk), *7th Workshop SDS 2012 STRUCTURAL DYNAMICAL SYSTEM: Computational Aspects*, Hotel Porto Giardino, Capitolo, Monopoli, Bari (Italy).

- December 21, 2012: “Filippov Sliding Vector Fields in Co-dimension 2” (10 minutes talk), *XMathS Workshop 2012*, University of Bari (Italy);
- March 16–20, 2013: “Filippov Sliding Vector Fields in Co-dimension 2”, (poster), *First International Conference on Dynamics of Differential Equations*, Georgia Institute of Technology, Atlanta, GA (USA).
- December 20, 2013: “Selection of Filippov Vector Fields for Discontinuous ODE’s” (15 minutes talk), *XMathS Workshop 2013*, University of Bari (Italy).
- June 10–13, 2014: “The Filippov Moments Solution On the Intersection of Two Surfaces” (25 minutes talk), *8th Workshop SDS 2014 STRUCTURAL DYNAMICAL SYSTEM: Computational Aspects*, Hotel Porto Giardino, Capitulo, Monopoli, Bari (Italy).
- December 18–19, 2014: “Minimum Variation Properties for Filippov Solutions on the Intersection of Two Surfaces” (15 minutes talk), *XMathS Workshop 2014*, University of Bari (Italy).
- June 22–26, 2015: Exploiting Hidden Structure in Matrix Computations. Algorithms and Applications, *CIME-EMS Summer School in applied mathematics*, Cetraro (Italy).
- December 16, 2015: “On the inverse of some sign matrices and on the Moments sliding vector field on the intersection of several manifolds: nodally attractive case” (45 minutes talk), University of Bari (Italy).
- December 21, 2017: “Control theory and optimization applied to industrial problems” (30 minutes talk), *XMathS Workshop 2017*, University of Bari (Italy).
- March 4, 2019: “Filippov theory, Richards’ equation and AGV”, (1 hour talk), Czech Technical University in Prague (Czech Republic).
- December 14–17, 2020: “Shooting the Numerical Solution of Linearized Moisture Flow Equation with Root Water Uptake Models” (20 minutes talk), *CMWR 2020 Computational Methods in Water Resources XXIII*, Stanford University (USA);
- December 21–23, 2020: “A mass conservative quadrature-based scheme for numerical solutions to Richards’ equation” (30 minutes talk), *XMathS Workshop 2020*, University of Bari (Italy).

- January 11–15, 2021: “A numerical recipe for root water uptake macroscopic models” within the mini symposium “Novel Modelling and Numerical Approaches for Flow and Transport Processes in Porous Media” (20 minutes talk), *14th World Congress on Computational Mechanics (WCCM XIV)*, *8th European Congress on Computational Methods in Applied Science and Engineering (ECCOMAS 2020)*, Paris (France).
- May 31–June 4, 2021: “Optimal Irrigation control in Richards’ Equation Framework” within the mini symposium “Subsurface Water Flow and Contaminant Transport Processes – Special Session in Honor of Harry Vereecken” (15 minutes talk), *InterPore 2021 online*, *13<sup>th</sup> annual meeting*.
- June 14–16, 2021: “A quadrature-based scheme for numerical solutions to Kirchhoff transformed Richards’ equation” (20 minutes talk), *18<sup>th</sup> UnTRIM Workshop 2021*.
- June 21–24, 2021: “A quadrature-based scheme for numerical solutions to Kirchhoff transformed Richards’ equation” (20 minutes talk), *SIAM 2021 Conference on Mathematical & Computational Issues in Geosciences*, Milano (Italy).
- September 6–10, 2021: Recent stability issues for linear dynamical systems. Matrix nearness problems and eigenvalue optimization, *CIME-EMS Summer School in applied mathematics*, Cetraro (Italy).

## PROJECTS

- Approval of research project N.812E4967, titled “New numerical model for the treatment of advection-diffusion equations with nonlinear and discontinuous terms for water transportation and infiltration in the vadose zone. Development of numerical solvers for the solution and application of the proposed model”, inside POR Puglia FESR FSE 2014 – 2020 – Asse X - Azione 10.4, Fondo Sociale Europeo “Research for Innovation (REFIN) per l’individuazione dei progetti di ricerca”.

## CERTIFICATIONS

- AMRx: Autonomous Mobile Robots, ETH Zürich, January 2018.
- Microsoft Certified: Azure AI Fundamentals, October 2020.

- Microsoft Certified: Azure AI Engineer Associate, November 2020 – November 2022.

## **AWARDS AND HONORS**

- Top Graduate Student Award in the School of Mathematics for the year 2015, Georgia Institute of Technology, Atlanta, GA (USA), April 2015;
- SIAM Student Chapter Certificate of Recognition, Academic Year 2013–2014, April 2014.

## **PROGRAMMING SKILLS**

- Matlab; Simulink;
- Python;
- Typescript; C#; C++ (basic).

## **AFFILIATIONS**

- SIAM (Society of Industrial and Applied Mathematics) 2013-2015;
- IAMG (International Associations for Mathematical Geosciences) 2020-2024.

## **REVIEW ACTIVITY**

Chaos: An Interdisciplinary Journal of Nonlinear Science; Mediterranean Journal of Mathematics; Applied Mathematics and Computation; Mathematical Reviews; Symmetry; Mathematics; Journal of Imaging; Applied Numerical Mathematics.

## **PUBLICATIONS**

### **Journal Papers**

1. F.V. Difonzo, C. Masciopinto, M. Vurro, M. Berardi, *Shooting* the numerical solution of moisture flow equation with root water uptake models: a Python tool numerical, *Water Resources Management* (2021). <https://doi.org/10.1007/s11269-021-02850-2>.

2. F.V. Difonzo, A note on attractivity for the intersection of two discontinuity manifolds, *Opuscula Mathematica* 40, no. 6 (2020), 685–702. <https://doi.org/10.7494/OpMath.2020.40.6.685>.
3. M. Berardi, F.V. Difonzo, L. Lopez, A mixed MoL-TMoL for solving 2D Richards' equation in layered soils, *Computers & Mathematics with Applications*, 2020, 79(7), pp. 1990-2001. <https://doi.org/10.1016/j.camwa.2019.07.026>.
4. M. Berardi, F.V. Difonzo, Strong solutions for Richards' equation with Cauchy conditions and constant pressure gradient, *Environmental Fluid Mechanics*, 2020, 20(1), pp. 165-174. DOI: 10.1007/s10652-019-09705-w.
5. M. Berardi, F. Difonzo, F. Notarnicola, M. Vurro, A transversal method of lines for the numerical modeling of vertical infiltration into the vadose zone, *Applied Numerical Mathematics*, 2019, 135, pp. 264-275. DOI:10.1016/j.apnum.2018.08.013.
6. M. Berardi, F. Difonzo, M. Vurro, L. Lopez, The 1D Richards' equation in two layered soils: a Filippov approach to treat discontinuities, *Advances in Water Resources*, Advances in Water Resources, 2018, 115, pp. 264-272. DOI: 10.1016/j.advwatres.2017.09.027.
7. L. Dieci and F. Difonzo, On the inverse of some sign matrices and on the Moments sliding vector field on the intersection of several manifolds: nodally attractive case, *Journal of Dynamics and Differential Equations*, 2017, 29(4), pp. 1355-1381. <https://doi.org/10.1007/s10884-016-9527-5>.
8. L. Dieci and F. Difonzo, The moments sliding vector field on the intersection of two manifolds, *Journal of Dynamics and Differential Equations*, 2017, 29(1), pp. 169-201. <https://doi.org/10.1007/s10884-015-9439-9>.
9. L. Dieci and F. Difonzo, Minimum Variation Solutions for Sliding Vector Fields on the Intersection of Two Surfaces in  $\mathbb{R}^3$ , *Journal of Computational and Applied Mathematics*, 2016, 292, pp. 732-745. <https://doi.org/10.1016/j.cam.2015.02.026>.
10. L. Dieci and F. Difonzo, A Comparison of Filippov Sliding Vector Fields in Co-dimension 2, *Journal of Computational and Applied Mathematics*, 2014, 262, 161-179. <https://doi.org/10.1016/j.cam.2013.10.055>.



Corrigendum in *Journal of Computational and Applied Mathematics*,  
2014, 272, pp. 273-273. <https://doi.org/10.1016/j.cam.2014.06.006>.

### Conference Proceedings

1. F.V. Difonzo, G. Girardi, On the shooting method applied to Richards' equation with a forcing term, *Gervasi O. et al. (eds) Computational Science and Its Applications – ICCSA 2021. ICCSA 2021. Lecture Notes in Computer Science*, vol 12949. Springer, Cham.  
[https://doi.org/10.1007/978-3-030-86653-2\\_20](https://doi.org/10.1007/978-3-030-86653-2_20).

Updated to October 2, 2021.