Fabio Miranda

Post Doctoral Research Associate

New York University

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Research Interests

I am interested in developing techniques that allow for the interactive visual analysis of large-scale data, combining methods from visualization, data management and computer graphics. My contributions have been published in premier conferences and journals, and have been featured in The New York Times, The Economist, Architectural Digest, among others.

Education

2012 - 2018 **Ph.D. in Computer Science** — *New York, NY, USA*
New York University (NYU)
Advised by Cláudio T. Silva.
Dissertation: “Data structures for the interactive visual analysis of urban data”.

2009 - 2011 **M.S. in Computer Science** — *Rio de Janeiro, RJ, Brazil*
Pontifical Catholic University of Rio de Janeiro (PUC-Rio)
Advised by Waldemar Celes.
Thesis: “Volume rendering of unstructured hexahedral meshes”.

2005 - 2009 **B.S. in Computer Science** — *Belo Horizonte, MG, Brazil*
Federal University of Minas Gerais (UFMG)
Advised by Luiz Chaimowicz.

Awards

2018 SIGMOD Best Demonstration Award
For “Interactive Visual Exploration of Spatio-Temporal Urban Data Sets Using Urbane”.

2018 Pearl Brownstein Doctoral Research Award
For doctoral research that shows the greatest promise, awarded by NYU.

2010-2012 CAPES and Petrobras Fellowships
Awarded during M.S. studies.

2006-2009 FINEP and CNPq Fellowships
Awarded during B.S. studies.

Selected Media Coverage

September 2017 Urban Pulse Uses Social Media Data to Show Cities in a New Light
Architectural Digest

September 2017 New program wants to improve cities with the power of tweets and Flickr uploads
Curbed

December 2016 Mapping the Shadows of New York City: Every Building, Every Block
The New York Times

October 2016 Listen to the music of the traffic in the city
The Economist

Publications

2020 Urban Mosaic: Visual Exploration of Streetscapes Using Large-scale Image Data
F. Miranda, M. Lage, H. Doraiswamy, M. Hosseini, G. Dove, C. T. Silva
2020 CHI Conference on Human Factors in Computing Systems (accepted for publication)

Learning Geo-Contextual Embeddings for Commuting Flow Prediction
Z. Liu, **F. Miranda**, W. Xiong, J. Yang, Q. Wang, C. T. Silva
Thirty-Fourth AAAI Conference on Artificial Intelligence (accepted for publication).

2019 Shadow Accrual Maps: Efficient Accumulation of City-Scale Shadows over Time
F. Miranda, H. Doraiswamy, M. Lage, L. Wilson, M. Hsieh, C. T. Silva
IEEE Transactions on Visualization and Computer Graphics, vol. 25, no. 3, pp. 1559-1574, Mar 2019.
Featured on The New York Times

2018 Time Lattice: A Data Structure for the Interactive Visual Analysis of Large Time Series
F. Miranda, M. Lage, H. Doraiswamy, C. Mydlarz, J. Salamon, Y. Lockerman, J. Freire, C. T. Silva
Computer Graphics Forum, vol. 37, no. 3, pp. 23-35, Jun 2018.

Interactive Visual Exploration of Spatio-Temporal Urban Data Sets using Urbane
H. Doraiswamy, E. Tzirita Zacharatou, **F. Miranda**, M. Lage, A. Ailamaki, C. T. Silva, J. Freire
2018 ACM SIGMOD Intl. Conf. on Management of Data - Demo.
Best Demonstration Award

Spatio-Temporal Urban Data Analysis: A Visual Analytics Perspective
H. Doraiswamy, J. Freire, M. Lage, **F. Miranda**, C. T. Silva
IEEE Computer Graphics and Application, vol. 38, no. 5, pp. 26-35, Sept/Oct 2018.

TopKube: A Rank-Aware Data Cube for Real-Time Exploration of Spatiotemporal Datasets
F. Miranda, L. Lins, J. Klosowski, C. T. Silva
IEEE Transactions on Visualization and Computer Graphics, vol. 24, no. 3, pp. 1394-1407, Mar 2018.

2017 Urban Pulse: Capturing the Rhythm of Cities
F. Miranda, H. Doraiswamy, M. Lage, K. Zao, B. Goncalves, L. Wilson, M. Hsieh, C. T. Silva
IEEE Transactions on Visualization and Computer Graphics, vol. 23, no. 1, pp. 791-800, Jan 2017.
Featured on The Economist, invited to SIGGRAPH 2017 TVCG special session

Data Visualization Tool for Monitoring Transit Operation and Performance
A. Kurkcu, **F. Miranda**, K. Ozbay, C. T. Silva
5th IEEE Intl. Conf. on Models and Technologies for Intelligent Transportation Systems (2017).

2016 TopKube: A Rank-Aware Data Cube for Real-Time Exploration of Spatiotemporal Datasets
F. Miranda, L. Lins, J. Klosowski, C. T. Silva
Data Systems for Interactive Analysis (DSIA) 2016.

2012 Volume Rendering of Unstructured Hexahedral Meshes
F. Miranda, and W. Celes
The Visual Computer Journal, vol. 28, no. 10, pp. 1005-1014, Oct 2012.

2011 Accurate Volume Rendering of Unstructured Hexahedral Meshes
F. Miranda, and W. Celes
24th Sibgrapi Conference on Graphics, Patterns and Images (2011).

Illustrative Volume Visualization for Unstructured Meshes Based on Photic Extremum Lines
A. Rocha, **F. Miranda**, and W. Celes
24th Sibgrapi Conference on Graphics, Patterns and Images (2011).

Research Experience

Fall 2018 - present **New York University** *New York, NY, USA*
Postdoctoral researcher
Development of new techniques for the interactive visualization of different types of large-scale data, such as streaming timeseries data and image data. Also responsible for mentoring PhD students.

Summer 2016 **Argonne National Laboratory** *Lemont, IL, USA*
Research intern
Mentor: Venkatram Vishwanath
Developed a visualization tool to explore high-resolution volumetric weather simulations, focused in the Chicago metropolitan area, in order to understand the impact of built environment on the city climate.

Summer 2015 **IBM T.J. Watson Research Center** *Yorktown Heights, NY, USA*
Research intern
Mentor: Bruce D'Amora
Developed a web-based graph visualization tool for the exploratory visualization of bitcoin transactions.

Summer 2014 **AT&T Research** *Middletown, NJ, USA*
Research intern
Mentors: Lauro Lins and James Klosowski
Developed a distributed version of *Nanocubes*, a datacube-based approach for the visualization of massive spatiotemporal datasets.

Summer 2013 **Sandia National Laboratories** *Albuquerque, NM, USA*
Research intern
Mentor: Patricia Crossno
Developed an adaptive kernel density estimation approach for scatterplots using GPUs.

2009 - 2012 **TecGraf / PUC-Rio** *Rio de Janeiro, Brazil*
Research assistant
Mentor: Waldemar Celes
Developed an unstructured hexahedral volume renderer for a data visualization and analysis software used in most of Brazil's oil fields.

Research Projects

Spring 2018 - present **Integrated Analytics and Visualization for Multi-modality Transportation Data** *New York University*
Cities are complex systems of interrelated dynamic components. A city's physical appearance plays an important role in this system but, due to its qualitative nature, measuring and modeling the urban appearance has for long been a challenge in urban studies. This requires the identification of areas in the city having similar characteristics, such as urban fabric, building facade, or even specific item of interest such as broken curbs. This projects leverages a new data set composed of tens of millions of images from New York City captured over a period of a year by cameras mounted on top of cars. It makes use of recent advances in computer vision to efficiently handle such a large collection of complex images and provide stakeholders with a visual perspective of the city that was not possible before.

Fall 2016 - present **SONYC: Sounds of New York City** *New York University*
Noise pollution is an important problem with broad-ranging societal effects that apply to a significant portion of the population. It is therefore imperative to analyze and understand noise pollution at city-scale in an interactive and efficient manner. As part of this project, hundreds of sensors were deployed throughout NYC, measuring the decibel level at each second. The analysis of such data demands new techniques that can efficiently handle high resolution temporal data, offering different stakeholders, such as city agencies, an unique opportunity to gain new insights about noise pollution

Fall 2015 - present **Urban Data Management and Analytics** *New York University*

Recent technological innovations have enabled the automatic collection of enormous amounts of diverse qualitative data from cities, through conventional sensors (e.g. noise levels), as well as through GPS sensors in vehicles (e.g. taxi trips) and mobile devices (e.g. social media data). The visual exploration of these data sets can greatly help in understanding not only the data and its underlying context, but also the dynamics of the city. However, given the sheer number and size of the datasets, this task presents computational challenges in several fronts, from indexing and querying to analyzing the data. This project takes first steps towards addressing these challenges, by proposing a framework that enables different stakeholders to interactively explore and analyze different data sets.

Fall 2015 - Fall 2016 **Data Storage and Access Platform for Transportation Data** *New York University*

Recent technological advances and extensive deployment of automated vehicle location technologies make GPS data sources a promising and cost-effective way to monitor transport system. In NYC,the bus system includes 233 routes, with more than five thousand buses and each bus provides a real-time update every 30 seconds, with information such as location and speed. This project proposes a powerful tool to acquire, store, process and visualize bus trajectory data, enabling stakeholders to determine how well the system is performing with respect to its service standards.

Summer 2014 - Spring 2016 **Data Structures for Exploratory Visualization** *AT&T Research*

With the ever-increasing amount of user-generated content found online, ranks have never been so popular to our cultural landscape. “What’s trending” has become a commonplace phrase used to capture the spirit of a time by looking at the most popular hashtags in a given region and time. This project proposes a data structure that can drive interactive visual exploration of top-k queries, considering spatiotemporal datasets.

2009 - 2012 **Large Scale Oil Reservoir Visualization** *TecGraf / PUC-Rio*

The output of oil reservoir simulations is often large, with unstructured volumes of potentially millions of cells. This project proposes techniques to efficiently, and accurately, visualize and explore such volumetric data, leveraging the power of massively parallel processing units.

Teaching Experience

Fall 2019 **CS GY 6533: Interactive Computer Graphics** *New York University*

Graduate course. Prepared and presented 2.5 hour lecture on shadows.

Fall 2014 **CS UY 1133: Data Structures and Algorithms** *New York University*

Undergraduate course. Prepared and presented 2.5 hour lecture on C and C++ programming.

Fall 2014 **CUSP GX 5003: Principles of Urban Informatics** *New York University*

Teaching assistant for Cláudio T. Silva, 50 students

Graduate course. Prepared and presented lectures on visualization, python, pandas and MySQL. Created and graded assignments, and held office hours.

Fall 2013 **CUSP GX 5003: Principles of Urban Informatics** *New York University*

Teaching assistant for Cláudio T. Silva, 50 students

Graduate course. Developed and presented lectures on visualization, python, javascript, D3 and MySQL. Prepared and graded assignments, and held office hours.

Mentoring Experience

2018 - **Mentor Ph.D. Students** *New York University*

Mentor students to work with the Urbane framework, as well as on research projects.

Students: Zhicheng Liu (CS PhD student at Southeast University, China), Maryam Hosseini (Urban Systems PhD student at Rutgers), Shaoyu Chen (CS PhD student at NYU), João Rulff (CS PhD student at NYU).

Talks

December 2018 — **Exploration of Street-Level Images at Scale** — *New York City, NY, USA*
Pedestrian Movement Technology Showcase at Metro North

November 2018 — **Shadow Accrual Maps: Efficient Accumulation of City-Scale Shadows over Time** — *Berlin, Germany*
IEEE Visualization Conference (VIS)

June 2018 — **Time Lattice: A Data Structure for the Interactive Visual Analysis of Large Time Series** — *Brno, Czech Republic*
EG/VGTC Conference on Visualization (EuroVis)

October 2017 — **TopKube: A Rank-Aware Data Cube for Real-Time Exploration of Spatiotemporal Datasets** — *Phoenix, AZ, USA*
IEEE Visualization Conference (VIS)

September 2016 — **Visualizing and Exploring Urban Data** — *Boston, MA, USA*
Data Visualization Summit

October 2016 — **TopKube: A Rank-Aware Data Cube for Real-Time Exploration of Spatiotemporal Datasets** — *Chicago, IL, USA*
Data Systems for Interactive Analysis Workshop (DSIA)

October 2011 — **Accurate Volume Rendering of Unstructured Hexahedral Meshes** — *Maceió, Brazil*
Sibgrapi Conference on Graphics, Patterns and Images

Selected Open-Source Projects

2019 — New York City Shadow Data
Shadow data for New York City, also used by The New York Times.

2018 — Urban Pulse
Open-source version of Urban Pulse paper.

2017 — Bus Explorer
Open-source tool for the exploration of a large data set with bus tracking pings. Developed in close collaboration with the New York City Department of Transportation.

Services

Program Committees: IEEE VIS 2019 Short papers, Sibgrapi 2019.
Reviewer: IEEE Transactions on Big Data, IEEE InfoVis, IEEE SciVis, IEEE VAST, Sibgrapi, WWW, The Visual Computer Journal.