

# 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 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.

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## 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.

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## 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.

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## 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 [↗](#)

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## Publications

### JOURNALS

- 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.
- 2018 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.
- 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](#)
- 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.

### CONFERENCES

- 2020 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).
- 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](#)
- 2017 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).
- 2011 Accurate Volume Rendering of Unstructured Hexahedral Meshes  
**F. Miranda**, and W. Celes  
24th Sibgrapi Conference on Graphics, Patterns and Images (2011).
- 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).

### WORKSHOPS

- 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.

## OTHERS

- 2019 Integrated Analytics and Visualization for Multi-modality Transportation Data  
C. Silva, J. Freire, **F. Miranda**, M. Lage, H. Doraiswamy, M. Hosseini, E. Tokuda, G. Ferreira, R. M. Cesar Jr.  
U.S. Transportation Collection.

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## 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 large scale 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.

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## 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 similar 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.

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## **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.

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## 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).

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## 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

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## 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. [↗](#)

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## Services

Program Committees: IEEE VIS 2019 Short papers, Sibgrapi 2019.

Reviewer: IEEE Transactions on Big Data, IEEE InfoVis, IEEE SciVis, IEEE VAST, Sibgrapi, The Visual Computer Journal.