Fabio Miranda

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RESEARCH INTERESTS

Data science • Urban data visualization • Large-Scale data visualization • Scientific visualization • GPGPU • Massively parallel architectures.

EDUCATION

New York University (NYU) .... 2012 - 2018
Ph.D. in Computer Science. Advisor: Dr. Claudio T. Silva.
Dissertation: "Data structures for the interactive visual analysis of urban data"

Pontifical Catholic University of Rio de Janeiro (PUC-Rio) .... 2009 - 2011
M.Sc. in Computer Science. Advisor: Dr. Waldemar Celes.
Thesis: "Volume rendering of unstructured hexahedral meshes"

Federal University of Minas Gerais (UFMG) .... 2005 - 2009
B.Sc. in Computer Science. Advisor: Dr. Luiz Chaimowicz.

RESEARCH EXPERIENCE

Postdoctoral researcher .... 2019 - present
New York University - New York City, NY, USA

Research Assistant .... 2012 - 2018
New York University - New York City, NY, USA
   Supervised by Dr. Claudio T. Silva.

Summer Research Intern .... Summer 2016
Argonne National Laboratory - Lemont, IL, USA
   Developed a visualization tool to explore high-resolution volumetric weather simulations, focused in the Chicago metropolitan area.
   Initial prototype used by climate scientists from Argonne and University of Notre Dame to understand the impact of urban morphology on the city climate.
   Supervised by Dr. Venkatram Vishwanath.

Summer Research Intern .... Summer 2015
IBM T.J. Watson Research Center - Yorktown Heights, NY, USA
   Developed a web-based large scale graph visualization tool for the exploratory visualization of bitcoin transactions.
   Supervised by Bruce D'Amora.

Summer Research Intern .... Summer 2014
AT&T Research - Middletown, NJ, USA
   Developed a distributed version of *Nanocubes*, a datacube-based approach for the visualization of massive datasets (∼1 billion records).
   Extended the initial *Nanocubes* proposal to support more complex queries, such as Top-K.
   Supervised by Dr. Lauro Lins and Dr. James Klosowski.

Summer Research Intern .... Summer 2013
Sandia National Laboratories - Albuquerque, NM, USA
   Developed an adaptive kernel density estimation approach for scatterplots using GPUs.
   Supervised by Dr. Patricia Crossno.

Research Assistant 2009-2012
Tecgraf/PUC-Rio - Rio de Janeiro, RJ, Brazil
   Developed an unstructured hexahedral volume renderer for a data visualization and analysis software used in most of Brazilian oil fields.
   Supervised by Dr. Waldemar Celes.

TEACHING EXPERIENCE

Teaching Assistant .... Fall 2013 and Fall 2014
New York University - Center for Urban Science and Progress
Principles of Urban Informatics
   Graduate-level class. Weekly lectures on Visualization, Python, Javascript, D3 and MySQL.
   Instructed by Dr. Claudio T. Silva.

Journals

- *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.

- *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.

- *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.

- *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.

- *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 and Workshops

- *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.

- *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).

- *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.

- *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).

- *Urban Pulse Uses Social Media Data to Show Cities in a New Light*
  Architectural Digest - September 25, 2017
  www.architecturaldigest.com/story/urban-pulse-uses-social-media-data-to-show-cities-in-a-new-light

- *New program wants to improve cities with the power of tweets and Flickr uploads*
  Curbed - September 22, 2017
  www.curbed.com/2017/9/22/16350214/urban-pulse-planning-design-cities-nyu

- *Mapping the Shadows of New York City: Every Building, Every Block*
  The New York Times - December 21, 2016
  www.nytimes.com/interactive/2016/12/21/upshot/Mapping-the-Shadows-of-New-York-City.html

- *Listen to the music of the traffic in the city*
  The Economist - October 22, 2016
  www.economist.com/news/science-and-technology/21709002-places-people-have-pulsesif-only-you-know-how-measure-them-listen

RESEARCH PROJECTS	**Urban Data Management and Analytics** .... **Fall 2015 - present** **New York University - New York City, NY, USA**

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 data sets, 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. In collaboration with Kohn Pedersen Fox architecture firm.
Project website: https://vgc.poly.edu/projects/urbane.

SONYC: Sounds of New York City .... **Fall 2016 - present**
New York University - New York City, NY, USA

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. In collaboration with NYU - Center for Urban Science and Progress (CUSP).
Project website: https://wp.nyu.edu/sonyc/.

Data Storage and Access Platform for Transportation Data .... **Fall 2015 - Fall 2016**
New York University - New York City, NY, USA

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.
In collaboration with NYC Department of Transportation and NYU - CUSP.
Project website: https://github.com/ViDA-NYU/BusExplorer.

Data Structures for Exploratory Visualization .... **Summer 2014 - Spring 2016**
AT&T Research - Middletown, NJ, USA

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. In this project, we propose a data structure that can drive interactive visual exploration of top-k queries, considering spatiotemporal datasets.
Project website: https://vgc.poly.edu/~fmiranda/topkube

Large Scale Oil Reservoir Visualization .... **2009 - 2012**
Tecgraf / PUC-Rio - Rio de Janeiro, RJ, Brazil

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.
In collaboration with Petrobras.
Project website: http://www.tecgraf.puc-rio.br/en/software/sw-geresim.html

AWARDS & HONORS	∘ SIGMOD 2018 Best Demonstration Award Interactive Visual Exploration of Spatio-Temporal Urban Data Sets using Urbane

∘ Pearl Brownstein Doctoral Research Award
Doctoral research that shows the greatest promise, awarded by NYU Tandon Sch. of Eng., 2018.

∘ NYU Tandon School of Engineering Fellowship, awarded during Ph.D.

∘ IEEE VIS 2016 Doctoral Colloquium Travel grant, 2016

∘ CAPES and Petrobras Fellowship, awarded during M.Sc., January 2010 - June 2012.

∘ FINEP Fellowship, awarded during B.Sc., March 2007 - March 2009.

∘ CNPq Fellowship, awarded during B.Sc., March 2006 - March 2007.

OPEN-SOURCE
SOFTWARE
PROJECTS

Urban Pulse

Urban Pulse is a framework that uses computational topology techniques to capture the pulse of cities. This is accomplished by first modeling the urban data as a collection of time-varying scalar functions over different temporal resolutions, where the scalar function represents the distribution of the corresponding acitivy over the city. The topology of this collection is then used to identify the locations of prominent pulses in a city. The framework includes a visual interface that can be used to explore pulses within and across multiple cities.

Website: https://github.com/ViDA-NYU/urban-pulse

Bus Explorer

Bus Explorer is a tool that makes it intuitive for different stakeholders to access bus trajectory data and to query it without any delay or external help. Moreover, the tool allows the users to conduct a series of data visualization and analysis operations demonstrating the potential of a such web-based tool for future applications. It has been developed in close collaboration with the New York City Department of Transportation.

Website: https://github.com/ViDA-NYU/BusExplorer

Nanocube

Nanocube is a data structure for in-memory data cubes, enabling low-latency queries for datasets with billions of elements. A distributed version of the structure enables different machines to handle different parts of a potentially even larger nanocube, while still maintaining interactivity.

Website: https://github.com/laurolins/nanocube/

OTHER

○ IEEE VIS 2016 Doctoral Colloquium, October 2016.

○ Reviewer: IEEE Transactions on Big Data, IEEE InfoVis (external reviewer), IEEE SciVis (external reviewer), IEEE VAST (external reviewer), The Visual Computer Journal, Sustainability Journal.