

# Vanessa Alexandra Freitas da Silva

## *Curriculum Vitae*

January, 2024

### Personal Information

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Web of Science <https://www.webofscience.com/wos/author/record/15368667>  
Scholar Citations <https://scholar.google.com/citations?user=0dqyFP4AAAAJ>

### Education

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- 2018-23 **PhD in Computer Science**  
Faculty of Science of the University of Porto, Porto, Portugal  
Thesis: "*Multidimensional Time Series Analysis: A Complex Networks Approach*"  
Advisors: Prof. Dr. Pedro Ribeiro and Profa. Dra. Maria Eduarda Silva
- 2016-18 **MSc in Networks and Informatics Systems Engineering**  
Faculty of Science of the University of Porto, Porto, Portugal  
Dissertation: "*Time Series Analysis based on Complex Networks*"  
Advisors: Prof. Dr. Fernando Silva, Prof. Dr. Pedro Ribeiro and Profa. Dra.  
Maria Eduarda Silva  
Grade: 19/20  
Final Grade: 17/20
- 2013-16 **Undergraduate Degree in Computer Engineering Sciences**  
Faculty of Science of the University of Porto, Porto, Portugal  
Final Grade: 16/20

## Pedagogical Experience

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SEP 2023 - | **Guest Professor**  
Faculty of Science of the University of Porto  
*Curricular units:*

- *Algorithms and Data Structures*, 1S
- *Algorithm Design*, 2S

SEP 2022 - AUG 2023 | **Guest Professor**  
Faculty of Science of the University of Porto  
*Curricular units:*

- *Algorithms and Data Structures*, 1S
- *Algorithm Design*, 2S

SEP 2021 - AUG 2022 | **Guest Professor**  
Faculty of Science of the University of Porto  
*Curricular units:*

- *Programming*, 1S
- *Algorithm Design*, 2S

## Research Experience

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SEP 2023 -	<b>Researcher</b> CRACS - INESC TEC
NOV 2018 - DEC 2022 (4 YEAR)	<b>PhD Researcher</b> - FCT Doctoral Grant CRACS - INESC TEC Thesis: " <i>Multidimensional Time Series Analysis: A Complex Networks Approach</i> " Supervisors: Prof. Dr. Pedro Ribeiro and Profa. Dra. Maria Eduarda Silva Reference: <b>SFRH/BD/139630/2018</b> Subject: Develop new tools for mapping (univariate and multivariate) time series into complex networks. Develop new tools for time series feature extraction based on topological measures.
AUG 2018 - DEC 2018 (5 MONTHS)	<b>Research</b> - Research Grant (BI) CRACS - INESC TEC Theme: " <i>Analysis of Time Series using Complex Networks</i> " Supervisor: Prof. Dr. Fernando Silva AND Prof. Dr. Pedro and Profa. Dra. Maria Eduarda Silva Ribeiro Project: <i>NanoSTIMA</i> Reference: <b>NORTE-01-0145-FEDER-000016</b>
MAR 2018 - JUL 2018 (5 MONTHS)	<b>Research</b> - Research Grant (BI) CRACS - INESC TEC Theme: " <i>Analysis of Time Series using Complex Networks</i> " Supervisor: Prof. Dr. Fernando Silva AND Prof. Dr. Pedro Ribeiro and Profa. Dra. Maria Eduarda Silva Project: <i>SMILeS</i> Reference: <b>NORTE-01-0145-FEDER-000020</b> Subject: Analysis, characterization and prediction of time series based on the analysis of complex networks. Study of several methodologies to convert series into a graph (e.g. visibility and transition probability). Analysis of the topologies of the created networks, looking for metrics based on existing literature.
NOV 2016 - MAY 2017 (7 MONTHS)	<b>Junior Researcher</b> - Junior Research Grant (BIC) CRACS - INESC TEC Theme: " <i>Evolutionary Network Analysis</i> " Supervisor: Prof. Dr. Fernando Silva and Prof. Dr. Pedro Ribeiro Project: <i>POCI</i> do CRACS - INESC TEC Subject: Strategies study to study the evolution of complex networks (dynamics), namely, the application of tensor factorization in the prediction of connections or evolution of thematic areas from co-authorship network obtained from Authenticus.

## Research Activity

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### *Domain of Specialization*

- Graph Theory and Network Science, with special interest in Multilayer Networks
- Time Series Analysis, with special interest in Multivariate Time Series
- Data Mining, with special interest in the areas of Statistics, Knowledge Discovery and Machine Learning.

### *Main Research Interests*

- Multivariate Time Series Analysis based on Complex Networks, given the promising results in univariate series analysis and the existence of complex structures (multilayer networks).
- Spatio-Temporal Data Analysis, given the large amount of data obtained through fixed and mobile sensors, associated with certain spaces on the planet.
- Univariate Time Series Analysis based on Complex Networks, given its potential.
- Complex Networks for Big Data, given the increasing need to analyze huge amounts of data and the power of network structures.
- Evolutionary Network Analysis, given that most complex networks are eminently dynamic, e.g. evolving over time, the parameters that characterize them may change.
- Data Analytics to decision support and to clustering, classification and forecasting applications.

## Conference Organization

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Member of the Organizing Committee on the following conference: MAPiS (“1st edition of MAPi International scientific meeting in the field of Computer Science for PhD students”).

- Program Chair and Publicity Chair

## Awards and Distinctions

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APR 2023 **BOLSA CLAD**  
By work “*Are multilayer networks useful for mining multivariate time series?*”, in the call for grants awarded by CLAD (Associação Portuguesa de Classificação e Análise de Dados) in XXX Jornadas de Classificação e Análise de Dados in Abril 2023 (JOCLAD2023)

APR 2023 **Award Fernando Nicolau**  
Attributed to Professor Dra. Maria Eduarda Silva for our joint article “*Novel features for time series analysis: a complex networks approach*” submitted in the journal *Data Mining and Knowledge Discovery* and published in March 2022

FEB 2023 **Top Cited Article**  
Certificate of (one of) the journal’s most cited articles of 2021-2022 *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, referring to the work with the title *Time series analysis via network science: Concepts and algorithms*”

## Publications

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Vanessa Freitas Silva, Maria Eduarda Silva, Pedro Ribeiro, and Fernando Silva. **Multilayer Quantile Graph for Multivariate Time Series Analysis and Dimensionality Reduction**. *Submitted to International Journal of Data Science and Analytics*, October 2023. A first version is available at arXiv <https://arxiv.org/abs/2311.11849>

Vanessa Freitas Silva, Maria Eduarda Silva, and Pedro Ribeiro. **Are multilayer networks useful for mining multivariate time series?**. In *JOCLAD2023 - Book of Abstracts - Viana do Castelo*, 20-22 April, April 2023.

Vanessa Freitas Silva, Maria Eduarda Silva, Pedro Ribeiro, and Fernando Silva. **MHVG2MTS: Multilayer Horizontal Visibility Graphs for Multivariate Time Series Analysis**. *Submitted to Transactions on Knowledge Discovery from Data*, December 2022. A first version is available at arXiv <https://arxiv.org/abs/2301.02333>

Vanessa Freitas Silva, Maria Eduarda Silva, Pedro Ribeiro, and Fernando Silva. **Novel features for time series analysis: a complex networks approach**. *Data Mining and Knowledge Discovery*, March 2022.

Vanessa Freitas Silva, Maria Eduarda Silva, Pedro Ribeiro, and Fernando Silva. **Multivariate Time Series Feature Extraction via Multilayer Networks**. *IFCS 2022 - Book of Abstracts - Porto*, 19-23 July, July 2022.

Vanessa Freitas Silva, Maria Eduarda Silva, Pedro Ribeiro, and Fernando Silva. **Time series analysis via network science: Concepts and algorithms**. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, e1404, Wiley, March 2021.

Vanessa Freitas Silva, Maria Eduarda Silva, and Pedro Ribeiro. **Time series analysis via complex networks: a first approach**. In *JOCLAD2019 - Book of Abstracts - Viseu*, 11-13 April, April 2019.

## Software

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### ***tsmnet* - Multidimensional Time Series Analysis via Multilayer Networks**

URL: *(available soon)*

A framework implemented in C++ to analyse multi-dimensional time series data using multilayer network analysis methodologies. Extracts time series networks (multilayer networks) resulting from univariate and multivariate mappings methods, and allows extracts sets of topological features.

### ***NetF* - A Novel Set of Time Series Features**

URL: <https://github.com/vanessa-silva/NetF>

R implementation to maps univariate time series data into three types of complex networks, namely, *Quantile Graphs*, *Weighted Natural Visibility Graphs* e *Weighted Horizontal Visibility Graphs*, and extracts (for each of them) five topological features, namely, *average weighted degree*, *average path length*, *clustering coefficient*, *number of communities* e *modularity*.