COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

Moises Levy

for the degree of Doctor of Philosophy (Ph.D.)

"New Family of Data Center Metrics using a Multidimensional Approach for a Holistic Understanding"

August 30, 2019, 9:00 a.m.
Engineering East 405
777 Glades Road
Boca Raton, FL

DEPARTMENT:
Computer and Electrical Engineering and Computer Science

ADVISOR:
Daniel Raviv, Ph.D.

PH.D. SUPERVISORY COMMITTEE:
Daniel Raviv, Ph.D., Chair
Ionut Cardei, Ph.D.
Jason O. Hallstrom, Ph.D.
Zvi Roth, Ph.D.

ABSTRACT OF DISSERTATION

Data centers' mission critical nature, significant power consumption, and increasing reliance on them for storing digital information, have created a need to monitor and manage these facilities. Metrics are a key part of this effort to raise flags that lead to optimization of resource utilization. While existing metrics have contributed to improvements regarding data center efficiency, they are very specific and overlook important aspects such as the overall performance and the risks to which the data center is exposed. With several variables affecting performance, there is an urgent need for new and improved metrics, capable to provide a holistic understanding of the data center behavior.

This research proposes a novel framework using a multidimensional approach for a new family of data center metrics. Performance is examined across four different sub-dimensions: productivity, efficiency, sustainability, and operations. Risk associated with each of those sub-dimensions is contemplated. External risks are introduced, namely site risk, as another dimension of the metrics. Results from metrics across all sub-dimensions can be normalized to the same scale and incorporated in one graph, which simplifies visualization and reporting. This research also explores theoretical modeling of data center components using a cyber-physical systems lens to estimate and predict different variables including key performance indicators. Data center simulation models are deployed in MATLAB and Simulink to assess data centers under certain a-priori known

conditions. The results of the simulations, with different workloads and IT resources, show quality of service as well as power, airflow and energy parameters. Ultimately, this research describes how key parameters associated with data center infrastructure and information technology equipment can be monitored in real-time across an entire facility using low-power wireless sensors. Real-time data collection may contribute in calibrating and validating models. The new family of data center metrics gives a more comprehensive and evidence-based view of issues affecting data centers, highlights areas where mitigating actions can be implemented, and allows reexamining their overall behavior. It can help to standardize a process that evolves into a best practice for evaluating data centers, comparing them to each other, and improving grounds for decision-making.

BIOGRAPHICAL SKETCH

Born in Caracas, Venezuela

B.S. in Electrical Engineering, Universidad Central de Venezuela, Venezuela, 1990

B.S. in Civil Engineering, Universidad Central de Venezuela, Venezuela, 1993

M.S. in Electrical Engineering, Universidad Central de Venezuela, Venezuela, 1994

Ph.D., Florida Atlantic University, Boca Raton, Florida, 2019

CONCERNING PERIOD OF PREPARATION
& QUALIFYING EXAMINATION

Time in Preparation: 2015-2019

Qualifying Examination Passed: Semester Spring 2016

Published Papers:

M. Levy, "Modeling and simulation of data centers to predict behavior," *American Journal of Science and Engineering*, vol. 1, no. 1. pp. 11–20, 2019.

M. Levy, D. Raviv, and J. O. Hallstrom, "Data center modeling using a cyber-physical systems lens," *2019 IEEE 9th annual computing and communication workshop and conference (CCWC)*. Las Vegas, NV, 2019.

M. Levy, D. Raviv, and J. Baker, "Data center simulations deployed in MATLAB and Simulink using a cyber-physical systems lens," *2019 IEEE 9th annual computing and communication workshop and conference (CCWC)*. Las Vegas, NV, 2019.

M. Levy, D. Raviv, and J. Baker, "Data center predictions using MATLAB machine learning toolbox," *2019 IEEE 9th annual computing and communication workshop and conference (CCWC)*. Las Vegas, NV, 2019.

M. Levy and D. Raviv, "An overview of data center metrics and a novel approach for a new family of metrics," *Advances in science, technology and engineering systems Journal*, vol. 3, no. 2. pp. 238-251, 2018.

M. Levy and D. Raviv, "A framework for data center site risk metric," *2017 IEEE 8th IEEE annual ubiquitous computing, electronics & mobile communication conference (UEMCON). Columbia University*, New York City, NY, 2017.

M. Levy and J.O. Hallstrom, "A reliable, non-Invasive approach to data center monitoring and management," *Advances in science, technology and engineering systems Journal*, vol. 2, no. 3. pp. 1577–1584, 2017.

M. Levy and D. Raviv, "A novel framework for data center metrics using a multidimensional approach," *15th LACCEI international multiconference for engineering, education, and technology*. Boca Raton, FL, 2017.

M. Levy and J.O. Hallstrom, "A new approach to data center infrastructure monitoring and management (DCIMM)," *2017 IEEE 7th annual computing and communication workshop and conference (CCWC)*. Las Vegas, NV, 2017.