FOURTH ANNUAL

Symposium on Transportation Informatics

Big Data Analytics Transforming Transportation Operations, Management and Safety

August 9 – 10, 2018

CENTER FOR TOMORROW, UNIVERSITY AT BUFFALO

TransInfo
Tier I University Transportation Center

University at Buffalo
School of Engineering and Applied Sciences

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

www.buffalo.edu/transInfo

CONTENTS

ACKNOWLEDGEMENTS

We would like to thank everyone who helped with the Fourth Annual Symposium:

Organizing Committee: Adel W. Sadek, Director, Transportation Informatics Tier I University Transportation Center (UTC) and Professor, Civil, Structural and Environmental Engineering, University at Buffalo; **Chunming Qiao**, SUNY Distinguished Professor and Chair, Computer Science and Engineering, University at Buffalo; **Ria Iliadou**, Coordinator of Strategic Initiatives, School of Engineering and Applied Sciences, University at Buffalo; **Joah Sapphire**, Founder and President of GDG IoT, and Research Support Specialist, University at Buffalo

School of Engineering and Applied Sciences Staff: Michelle Bowen, Jennifer Giegel, Dayeabasi Martin Akpan

Special thanks to **Stephen E. Still**, Professor of Practice, University at Buffalo

WIFI

- To log in, make sure all your browsers are closed
- Connect to **UB_Connect** through WI-FI
- Open your browser (preferably chrome), it will direct you to a splash screen to then enter an e-mail to gain access to the internet
- If it doesn't automatically direct you, try typing in a web address (google, cnn, etc) and it should then direct you

WELCOME FROM THE DIRECTOR

Welcome to the Fourth Annual Symposium on Transportation Informatics, titled "Big Data Analytics Transforming Transportation Operations, Management and Safety".

TransInfo is currently conducting cutting edge research utilizing big data analytics to improve all aspects of transportation. This research ranges from developing predictive border crossing delay models to new performance metrics and operational strategies for public transportation. Our goal is to highlight this research as well as bring together leading transportation practitioners from the public and private sector.

We are delighted to present a full program of exciting new research, collaboration between academia and industry, and an opportunity to speak with leading researchers in the transportation industry.

In addition, this year, we are shining the spotlight on the challenges and opportunities of Connected and Automated Vehicles (CAVs) applications, testing and evaluation with invited speakers, presentations in the area of CAVs delivered by top researchers and industry leaders and a panel discussion.

The Symposium is a joint effort of the University at Buffalo and the TransInfo University Transportation Center. The Vice President for Research & Economic Development of the University at Buffalo, Venu Govindaraju and the Dean of the School of Engineering & Applied Sciences Dr.Liesl Folks will inaugurate the proceedings.

We hope you enjoy the diverse swathe of presentations we have selected for this year's Symposium. As always, participants are encouraged to ask questions about every project and idea – this is a place for discussion and discovery, much like the industry in which we work.

On behalf of the Transportation Informatics Tier I University Transportation Center, please enjoy the Fourth Annual Symposium on Transportation Informatics: "Big Data Analytics Transforming Transportation Operations, Management and Safety".

Adel Sadek
Director, TransInfo,
University at Buffalo

ABOUT TRANSINFO

Transportation Informatics (TransInfo) University Transportation Center (UTC) leverages its partnership with top-tier transportation research universities to collaborate with government, industry, academia, and policy makers around the globe in search of transportation solutions by mining the wealth of big data available and employing a wide variety of methods, tools and models, including artificial intelligence (AI), machine learning, statistics, and database systems.

TransInfo has funded research projects in five research domains:

- Transportation Operations
- Safety, Efficiency and Sustainability
- Public Transportation
- Performance Measurement
- Travel Behavior Modeling

TransInfo is a consortium of four member national universities, University at Buffalo (lead university), Rensselaer Polytechnic Institute, George Mason University and the University of Puerto Rico-Mayagüez, and one non-member research corporation, CUBRC, located in Buffalo, N.Y.

Headquartered at the University at Buffalo, TransINFO is led by Adel Sadek, Professor in the Department of Civil, Structural and Environmental Engineering. In addition to faculty from the Department of Civil, Structural and Environmental Engineering, TransInfo also includes faculty from the Departments of Computer Science and Engineering, and Industrial and Systems Engineering as well as partners from both the public and private sector. TransInfo is funded by the USDOT's Office of the Assistant Secretary for Technology and Research (OST-R).

TRANSINFO FACULTY

UNIVERSITY AT BUFFALO

Adel Sadek
Director of TransInfo Tier I University Transportation Center; Stephen Still ISTL Founding Director; Associate Director, Industry Consortium and Steering Committee member; Professor; Director of the Transportation Systems Engineering Lab; Chair of UB 2020's Strategic Strength in Extreme Events, Civil, Structural and Environmental Engineering, School of Engineering and Applied Sciences

Panos Anastasopoulos
Associate Professor, Civil Structural and Environmental Engineering;
Director, Engineering Statistics and Econometrics Application Research Lab;
Director, Stephen Still Institute for Sustainable Transportation and Logistics

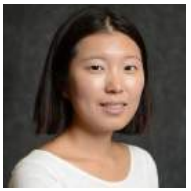
Rajan Batta
Associate Dean, Research and Graduate Education, School of Engineering and Applied Sciences
Industrial and Systems Engineering, School of Engineering and Applied Sciences

Lora Cavuoto
Assistant Professor, Department of Industrial and Systems Engineering

Jing Gao
Assistant Professor, Computer Science and Engineering

Venugopal (Venu) Govindaraju
SUNY Distinguished Professor, Computer Science and Engineering;
Vice President, Research and Economic Development;
Founding Director, Center for Unified Biometrics and Sensors (CUBS);
Associate Director, Center of Excellence for Document Analysis and Recognition (CEDAR)

Daniel B. Hess
Associate Professor, Urban and Regional Planning

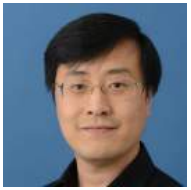


Jee Eun "Jamie" Kang
Assistant Professor, Industrial and Systems Engineering

Sara Metcalf
Associate Professor, Geography

JiYoung Park
Assistant Professor, Urban and Regional Planning

Chunming Qiao
Department Chair; SUNY Distinguished Professor; Adjunct Professor, Electrical Engineering, Computer Science and Engineering



Lu Su
Assistant Professor, Computer Science & Engineering

Jose Walteros
Morton C. Frank Endowed Assistant Professor, Department of Industrial and Systems Engineering

Le Wang
Associate Professor, Geography

Qian Wang
Assistant Professor, Civil, Structural and Environmental Engineering

Eun-Hye Enki Yoo
Assistant Professor, Geography

Qing He
Assistant Professor, Stephen Still ISTL;
Joint appointment with Civil, Structural and Environmental Engineering and Industrial and Systems Engineering

RENSSELAER POLYTECHNIC INSTITUTE

Xuegang (Jeff) Ban (currently with the University of Washington)
Associate Professor, Civil and Environmental Engineering, University of Washington

Jose Holguin-Veras
Professor, Civil and Environmental Engineering

Xiaokun (Cara) Wang
Assistant Professor, Civil and Environmental Engineering

GEORGE MASON UNIVERSITY

Shanjiang Zhu
Assistant Professor, Civil, Environmental, and Infrastructure Engineering

Mohan M. Venigalla
Associate Professor, Civil, Environmental, and Infrastructure Engineering

UNIVERSITY OF PUERTO RICO

Ivette Cruzado Vélez
Associate Professor, Civil Engineering

Didier M. Valdes-Diaz
Professor, Civil Engineering

Manuel Rodriguez-Martinez
Professor, Computer Science & Engineering

Dr. Daniel Rodriguez-Roman
Assistant Professor, Civil Engineering at the University of Puerto Rico, Mayagüez (UPRM)

AGENDA

Thursday, August 9, 2018

7:45 a.m.	**Registration Opens** Coffee and continental breakfast provided
8:30 a.m. – 9:00 a.m.	**Welcoming Remarks** • Adel Sadek, PhD, Director of Transportation Informatics Tier I University Transportation Center, Professor, State University of New York at Buffalo • Liesl Folks, PhD, MBA, Dean of the School of Engineering and Applied Sciences at the State University of New York at Buffalo • Venu Govindaraju, PhD, Vice President for Research & Economic Development of the State University of New York at Buffalo
9:00 a.m. – 10:20 a.m.	**Session 1: Big Data Analytics** **Chair:** Shanjiang Zhu, PhD, Assistant Professor, Sid and Reva Dewberry Department of Civil, Environmental, and Infrastructure Engineering, Volgenau School of Engineering, George Mason University
9:00 a.m. – 9:20 a.m.	**Andrew Bartlett, PhD, NITTEC** Predicting Border Crossing Delay through Newly Available Real-Time Data and Deep Learning Methods
9:20 a.m. – 9:40 a.m.	**Yu Cui, PhD Candidate, University at Buffalo** Sampling Bias Correction in Using Social Media for Travel Behavior Analysis by Predicting the Demographics of Social Media Users
9:40 a.m. – 10:00 a.m.	**Enshu Wang, PhD Candidate, University at Buffalo** A Cost-effective Routing and Recharging Recommendation System for Electric Taxi Drivers

10:00 a.m. – 10:20 a.m.	**Shanjiang Zhu, PhD, George Mason University** Assessing Travel Behavior Responses to Washington Metro SafeTrack Project Based on an Integrated Data Platform
10:20 a.m. – 10:40 a.m.	**Coffee Break**
10:40 a.m. – 12:00 p.m.	**Session 2: Connected Vehicles (CV) & Autonomous Vehicles (AV) Applications & Testing** **Chair:** Chunming Qiao, PhD, SUNY Distinguished Professor & Chair, Computer Science & Engineering, University at Buffalo
10:40 a.m. – 11:00 a.m.	**Paul M Torrens, PhD, New York University** Virtual Pedestrian Environments
11:00 a.m. – 11:20 a.m.	**Jee Eun Kang, PhD, University at Buffalo** Service Design and Operations of Autonomous Car-Sharing Systems
11:20 a.m. – 11:40 a.m.	**Joah Sapphire, Founder and President of GDG IoT** Buffalo Principles for Sustainable Real-World Deployment of Autonomous Vehicles
11:45 a.m. – 2:00 p.m.	**Lunch & Technical Demonstration**
2:00 p.m. – 2:45 p.m.	**Session 3: Keynote Speaker** **Alain L. Kornhauser,** PhD, Professor of Operations Research & Financial Engineering at Princeton University; Director, Transportation Program, Faculty chair, Princeton Autonomous Vehicle Engineering (PAVE)
2:45 p.m. – 3:00 p.m.	**Coffee Break**

3:00 p.m. – 4:15 p.m.

Session 4: Panel Discussion on Autonomous Vehicles Applications & Testing

Panel Moderator:
Stephen E. Still, Professor of Practice, University at Buffalo; Founder and Former Managing Director, Seabury Airline Planning Group, LLC

Panelists:

- Robyn Marquis, PhD, Project Manager, Clean Transportation, NYSERDA
- Terence J. McDonnell, Staff Sergeant, New York State Police
- Michael Brown, PMP, Southwest Research Institute
- David C. Duchscherer, PE, FASE, Chairman, Board of Directors, Wendel, LLC
- Matthew Rivett, Executive Vice President, Local Motors

Reception at the Center for Tomorrow Courtyard following the conclusion of the Panel Discussion

Friday, August 10, 2018

7:45 a.m.

Registration Opens
Coffee and Continental breakfast provided

8:30 a.m. – 9:15 a.m.

Session 5: Keynote Speaker

Raj Rajkumar, PhD, George Westinghouse Professor, Carnegie Mellon University; Director, Metro21: CMU's Campus-Wide Initiative on Smart Cities; Director, USDOT Mobility21 National University Transportation Center; Director, USDOT T-SET National University Transportation Center; Co-Director, General Motors-Carnegie Mellon Connected and Autonomous Driving Collaborative Research Lab (CAD-CRL); Director, Real-Time and Multimedia Systems Lab

Friday, August 10 - Continued

9:15 a.m. – 10:15 a.m.

Session 6: Informatics Utilization in Safety

Chair: Qing He, PhD, Stephen Still Assistant Professor, University at Buffalo

9:15 a.m. - 9:35 a.m.

Ivette Cruzado, PhD, University of Puerto Rico at Mayagüez
CARS Mobile Application, Its Side Projects, and Future Work

9:35 a.m. – 9:55 a.m.

Lora Cavuoto, PhD, University at Buffalo
Commercial Driver Workload and Risky Behavior Evaluation Using Naturalistic Driving Data

9:55 a.m. – 10:15 a.m.

Kevin Majka, PhD, CUBRC
An Evaluation of Knowledge Discovery & Dissemination Techniques for Big Data Transportation Research

10:15 a.m. – 10:30 a.m.

Coffee Break

10:30 a.m. – 12: 00 a.m.

Session 7: Informatics Utilization in Public Transportation

Chair: Ivette Cruzado, PhD, Associate Professor in the Civil Engineering and Surveying Department, University of Puerto Rico at Mayagüez

10:30 a.m. – 10:50 a.m.

John Handley, PhD, University of Rochester/Goergen Institute for Data Science
Portfolio Analytics for Public Transit Fare Classes

10:50 a.m. – 11:10 a.m.

Daniel Rodriguez-Roman, PhD, University of Puerto Rico at Mayaguez
Predicting Trip Cancellations and No-Shows in Paratransit Operations

11:10 a.m. – 11:30 a.m.

Xiaohang Zhu, PhD Candidate, University at Buffalo
Paratransit Routing and Overbooking: Accounting for No-Shows and cancellations

11:30 a.m. – 11:50 a.m.	**Laiyun Wu, PhD Candidate, University at Buffalo** Inferring Origin-Destination and User Preference in Multi-modal Travel Environment by Using Automated Fare Collection data
11:50 a.m. – 12:10 p.m.	**Sandeep Mudigonda, Research Associate, Region 2 University Transport Research Center** A 'Reinventing Mobility' Framework Co-Designed with Experts in New York State: Exploring the Long-Term Impacts of Shared, Connected, Automated and E-mobility Systems Transformations
12:10 p.m.	**Symposium Closing Remarks**

KEYNOTE SPEAKERS

Alain L. Kornhauser, PhD

Professor of Operations Research & Financial Engineering at Princeton University; Director, Transportation Program; Faculty chair, Princeton Autonomous Vehicle Engineering (PAVE)

Alain Kornhauser is Professor of Operations Research & Financial Engineering at Princeton University. Born in France, he immigrated to western Pennsylvania with his parents at the age of 7. He studied Aerospace Engineering at Penn State where he obtained a BS and MS. His research, focused on cavitation, earned him and his advisor, JW Holl, one of the highest ASME prizes, the Melville medal. He then transferred to Princeton's Aerospace and Mechanical Sciences Department, earning a PhD. in the Fall of 1970. He then joined the faculty of the Aerospace Engineering Department at the U of Minnesota as an assistant professor in January 1970. During his tenure he worked closely with Professors Wm. Garrard and Edward Anderson applying automation, network analysis and optimal control to transit vehicles. Together they made the UofM the leading research center for this then new form of urban transit. Prof. Kornhauser returned to Princeton in the Fall of 1972 and continued his pivotal work in the network design and operational analysis of PRT. While at Princeton, he extended the large scale PRT network analysis capabilities to more conventional forms of transportation, rail and highway, creating the Princeton Transportation Network Model which pioneered the application of Geographic Information Systems in the quantitative analysis of large-scale transportation systems. Included in PTNM/GIS was the creation of the first digital map database of the North American Railway and Highway systems. PTNM/GIS proved pivotal in the restructuring of the bankrupt Northeast freight railroad system. In 1979 he founded ALK Technologies, Inc. that enhanced and utilized PTNM/GIS to assist the private North American Railroad System to rationalize its network structure and implement substantial operational efficiencies, including the creation of the first computer-graphic Operation Control Center at Canadian National and the first Optimal Locomotive Management System at Burlington Northern. ALK has evolved to create the standard digital map database for the North American roadway and railway systems that is used today by essentially every railroad and trucking company in North America. He has also been a pioneer in the development and market acceptance of turn-by-turn navigation systems.

ALK's CoPilot system was the first nationwide GPS system on the market in August, 1997 and its current smartPhone and Tablet versions have gained substantial consumer acceptance around the world. After 33.5 years, he sold ALK to Trimble Navigation in December 2012. At Princeton, Prof. Kornhauser is in his 43 rd year on the Princeton faculty in the Fall 0f 2014 as Professor of Operations Research & Financial Engineering. He serves as Director of the Transportation Program where he continues his basic research in Transportation. He was the Faculty Leader of Princeton's entries the 2005 DARPA Grand Challenge and 2007 Urban Challenge and continues his interest in the complete automation of the automobile with particular interest in the autonomousTaxi concept and its potential to transform mass transit and deliver ubiquitous mobility to everyone. He is Faculty Chair of Princeton Autonomous Vehicle Engineering (PAVE) and extracurricular undergraduate Smart Driving Car research effort at Princeton, Editor of the Smart Driving Cars Newsletter (www.SmartDrivingCar.com) and Board Chair of the Advanced Transit Association (ATRA). Professor Kornhauser completed his 14th NYC Marathon in November 2012 by running his own 26.2 miles during NYC Marathon Sunday in lieu of the cancelled event.

Raj Rajkumar, PhD

George Westinghouse Professor, Carnegie Mellon University; Director, Metro21: CMU's Campus-Wide Initiative on Smart Cities; Director, USDOT Mobility21 National University Transportation Center; Director, USDOT T-SET National University Transportation Center; Co-Director, General Motors-Carnegie Mellon Connected and Autonomous Driving Collaborative Research Lab (CAD-CRL); Director, Real-Time and Multimedia Systems Lab.

Raj Rajkumar is professor in the department of electrical and computer engineering at Carnegie Mellon University. He is a technical staff member at the Software Engineering Institute at Carnegie Mellon University, and he also plays the role of a research staff member at IBM Thomas J. Watson Research Lab.

Other roles include:

- Primary Co-founder, TimeSys Corporation.

- Consultant for several companies in the technological space.

- Scientific Advisory Board for Centers of Excellence.

He specializes in embedded systems, real-time systems, operating systems, distributed systems, automotive systems, smartphones, wireless sensor networks, resource management, cybersecurity and physical security, cyber-physical systems, networking and QoS.

Dr. Rajkumar worked as a Research Staff Member at IBM for two years (1989-1992), afterwards he joined the Software Engineering institute in 1992 and stayed with them for three years. Raj went ahead and joined TimeSys cooperation in 1996 and stayed with them for five years. Finally, he began working at Carnegie Mellon University in September, 2004, where he began as a Co-Director and now, is the George Westinghouse Professor of Electrical and Computer Engineering at Carnegie Mellon University.

Dr. Rajkumar and other scientists like him explore the many intricate engineering domains of vehicle operation in their quest for some answers to what's possible in the cars of tomorrow.

Perhaps you already think of your car as a "companion." Faculty like Dr. Rajkumar are thinking of ways to bring your vehicle to life with Information technology — giving you a car that will know you and help you, Inform and entertain you, and even take care of itself like a proper traveling companion.

PANELISTS

Panel Moderator: Stephen E. Still, PhD

Professor of Practice, University at Buffalo, SSISTL; Founder and Former Managing Director, Seabury Airline Planning Group, LLC

Dr. Still has more than 25 years experience in consulting and management of transportation systems, including 20 years of hands-on experience in aviation planning.

He has managed aviation projects worldwide including assignments for airlines, equipment manufacturers, and financial advisory firms. Recent projects include wide body fleet analysis leading to a multi-billion dollar fleet order, optimization of network structure for a major U.S. carrier, development of new planning methods for a large Asian airline, and an assessment and outlook for the US.

Stephen specializes in a variety of corporate planning functions including route and fleet strategy, financial analysis, and revenue management.

Prior to Seabury APG, he was Director, Corporate Planning, with US Airways, Inc., responsible for development of strategic initiatives for routes, fleets and alliances. He was responsible for formulating and coordinating the airline's fleet plans, including analysis leading up to a multi-billion dollar fleet purchase.

Dr. Still is a frequent presenter at airline and transportation conferences, and teaches professional courses for the International Air Transport Association (IATA), and holds a PhD in Civil Engineering and Operations Research from Princeton University with a specialty in Transportation Systems and Economics. He earned a BS in Engineering from the University at Buffalo, magna cum laude, with a concentration in transportation planning. He has also completed courses in advanced demand modeling at the Massachusetts Institute of Technology.

Dr. Still is the Eponym Benefactor of UB's Stephen Still Institute for Sustainable Transportation & Logistics

Panelist: Michael Brown, PMP

Southwest Research Institute

Mike Brown is an Institute Engineer for Southwest Research Institute (SwRI). He has been a leader in the development of intelligent systems for over twenty-one years. Mr. Brown has served various federal, state, and commercial clients in projects spanning the areas of Advanced Traffic and Traveler Information Systems, Smart Cities, Connected Vehicle Systems, and Vehicle Automation. Mr. Brown is a subject matter expert for numerous standards committees in standards development organizations including Institute of Electrical and Electronics Engineers (IEEE), Society of Automotive Engineers (SAE) and International Organization for Standardization (ISO).

Panelist: David C. Duchscherer, PE, FASE

Chairman, Board of Directors, Wendel, LLC

David C. Duchscherer is a Professional Engineer and a principal of Wendel LLC. The firm is nationally recognized as specialists in public transportation facilities planning and design. Having designed projects throughout the United States, Mr. Duchscherer's personal involvement in projects is a signature of the company. With almost 50 years of experience, he is a licensed professional engineer in many states. Often sought for his expertise in public transportation design, Mr. Duchscherer has been a featured speaker at many industry conventions and has authored and co-authored over 30 papers and articles regarding building, design, construction and public transportation. He holds an MS in Civil Engineering from the University at Buffalo.

Panelist: Robyn Marquis, PhD

NYSERDA

Dr. Robyn Marquis is a Project Manager on the Clean Transportation team at the New York State Energy Research and Development Authority (NYSERDA). Robyn oversees a broad portfolio of transportation projects and initiatives that includes policy research, product development and demonstration, and statewide deployment related to electric vehicles, public transportation,

mobility management, and freight. She manages a collaborative research program with the New York State Department of Transportation, which emphasizes efficient mobility solutions. Before joining NYSERDA, Robyn completed a B.S. in Civil Engineering and an M.S. and Ph.D. in Transportation Engineering at Rensselaer Polytechnic Institute (RPI) in Troy, NY. While at RPI, she researched the impacts of curbside management strategies on driver behavior and congestion.

Panelist: Terence J. McDonnell

Staff Sergeant, New York State Police

Staff Sergeant Terry McDonnell is a 31 year veteran of the New York State Police who has spent more than 25 years developing traffic safety programs and implementing traffic safety technologies. He is a member of the Highway Safety Committee of the International Association of Chiefs of Police and the Autonomous Vehicles Working Group of the American Association of Motor Vehicle Administrators.

Panelist: Matthew Rivett

Executive Vice President, Local Motors

Matthew Rivett is a leading player and driving force in automotive innovation. Currently the Executive Vice President of Local Motors, Inc., Matthew was a critical contributor to the development and manufacturing of Olli, the first ever co-created, self-driving shuttle. In collaboration with key stakeholders to raise funds and create innovative manufacturing processes, Matthew, oversaw the opening of Local Motors first international facility and expanding the business to ensure further development of Olli. Prior to working on the Olli, Matthew produced the world's first 3D printed vehicle called the Strati. Through his efforts in Program Management, crowd sourcing and collaborations with the Oakridge National Lab and Cincinnati Machine tools, the Strati became a reality. Previous to his tenure at Local Motors, Matthew served as a Project Manager and Ship Superintendent for Portsmouth Naval Shipyards. He worked in this capacity on two separate occasions, managing multi-million-dollar projects and organizing the repair and logistics involved in repairing and upgrading home-ported and visiting submarines. It was in this role that Matthew led the first ever waterborne nuclear piping repair.

This was an overreaching project that required the management of a $5 million budget and collaboration between two major shipyards in New Hampshire and Washington State. Matthew earned a Bachelor of Science Degree in Project Management in 2013 and several other certifications while serving in the United States Military where he held the top-level DoD security clearance. He currently still serves as the Chief Operations Officer for Local Motors, Inc. where he oversees 60+ professionals located across three different facilities. Administrators.

SPONSORS

TransInfo
Tier I University Transportation Center

University at Buffalo
School of Engineering and Applied Sciences

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

TRANSINFO PARTNER ORGANIZATIONS

University at Buffalo
The State University of New York

CUBRC

RENSSELAER POLYTECHNIC INSTITUTE
1824

GEORGE MASON UNIVERSITY

RECINTO UNIVERSITARIO DE MAYAGÜEZ
CAAM
UNIVERSIDAD DE PUERTO RICO