Graduate Studies in Engineering and Computer Science at the University of Central Florida

Department of Civil, Environmental and Construction Engineering
## Department of Civil, Environmental and Construction Engineering (CECE)

### Research Areas:
- Smart Cities
- Water resources and quality
- Structural health monitoring
- Infrastructure
- Transportation
- Traffic safety
- Environmental engineering
- Sinkholes and other geotechnical topics

### Faculty and Students

<table>
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<th>Faculty and Students</th>
<th>Faculty</th>
<th>Lecturers</th>
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<td>26</td>
<td>3</td>
<td>95</td>
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### Facts of Interest:
- $6.175 mil research expenditure in 2016/2017
- 900 undergraduates
- 167 graduate students
- 106 journal articles in 2016/17
- World’s largest rainfall simulator; sinkhole simulator
- Modeling capabilities in Water Resource's, Structures
- Structures and water processes analytical/experimental labs
FUTURe CITY

Key Stakeholders:
Residents, tourists, government, NGOs, and Infrastructure, consulting, and vehicular tech companies

Vehicle Technology
- Connected (V2V and V2I) and autonomous vehicles
- Ridesharing (automobile and bicycle)

Sustainable City
- Inclusive regional planning
- Healthy communities

Human Infrastructure
- Public governing agencies and communities
- Integration with tourism sector

Data Collection and Storage
- Smart city infrastructure monitoring
- “Big Data” using artificial intelligence

Disaster Management
- Hurricane and flood prediction
- Real-time evacuation management

Service Evaluation
- Integrated arterial traffic management
- Water quality and air quality measurement

Structures
- Smart buildings, Structural health monitoring, Building information modeling

Environment
- Drinking water and recycling
- Waste management and landfills

Inter-disciplinary Techniques
- Internet of things, Virtual, augmented and mixed Reality, Cyber security
Big Data Applications, Safety, Simulation, Traffic Management

Dr. Mohamed Abdel-Aty, PE

- ITS Traffic Detection System
  - Strength of ITS
    - High Deployment Density
    - Real-time Monitoring
  - Congestion
    - Time duration
    - Congestion area
    - Congestion intensity
  - Safety
    - Crash precursors
    - Crash’s effects
Directional Diamond Interchange
Proposed new design to enhance capacity and level of service

Using Micro-simulation for Pedestrian Safety Surrogate Measures
The Built Environment

real-time streaming BIG DATA

Sensors & Devices

Mobility Innovation

Understanding the City

Visit us: http://www.cecs.ucf.edu/shasan
Transportation Modeling

- Studying behavior employing advanced mathematics
  - Formulate new econometric models
  - New estimation approaches
  - Agent based micro-simulation platforms

Montreal Bikeshare

- Research Areas
  - Transportation Planning
    - Freight modeling
    - Connected vehicle technologies, Driverless technologies
    - Public transit ridership and bicycle sharing systems
  - Transportation Health and Equity
    - Quantifying the influence of traffic pollution on public health and equity issues

Research Areas
- Transportation Safety
  - Traffic crash analysis of driver injury
  - Pedestrian and bicyclist injury
- Statistics
  - Data mining, Data pooling, and Big data analytics

Spatial Distribution of Florida Bicycle-Motor Vehicle Crash Frequency

http://www.people.cecs.ucf.edu/neluru/index.html
Department of Civil, Environmental and Construction Engineering (CECE)

Traffic Operations and Safety

Haitham Al-Deek, PhD, PE


• UCF Wrong-Way Driving (WWD) Hotspots™ Methodology and Optimization Model

  Identifying WWD hotspots for appropriate countermeasure treatment to produce the most cost efficient reduction in WWD crash risk. Won two best paper awards.
Low-cost sensor for air pollution measurement

Dr. Haofei Yu

- Traditionally, pollution concentration measured at stationary stations
  - Expensive, limited locations, need bulky/complex equipment and trained personals
- Low-cost and portable air pollution sensors have the potential to considerably enhance the capabilities of existing air pollution monitoring network
- Low maintenance and easy-to-use features of sensors also enable in-depth public participations in air quality research and advances citizen science

Sensor package.
20(L)×10(W)×7cm(H)

A test measurement path

Measured PM$_{2.5}$ concentration
Civil Infrastructure Technologies for Resilience and Safety (CITRS)

CITRS Group
Safe, resilient, smart, sustainable civil infrastructure systems

- Non-destructive evaluation
- Advanced modeling and analysis, multiple hazard assessment
- Life-cycle assessment and life-cycle cost
- Material-, component-, and large-scale testing
- Novel and nanotech-based materials for civil infrastructure
- Sustainable and green structures
- Bridges, buildings, highway structures, pavements, roads, stadiums, convention centers, airports, ports, dams, tunnel, lifelines
- Structural health monitoring and identification with novel sensing, analysis, and predictive analysis approaches
- Reliability and probabilistic assessment
- Advanced modeling and analysis, multiple hazard assessment

UCF Civil, Environmental, and Construction Engineering

Necati Catbas
Kevin Mackie
Andrew Yun
Boo Nam
Omer Tatari
Department of Civil, Environmental and Construction Engineering (CECE)

  - Dr. Luis G. Arboleda-Monsalve

- Field performance and instrumentation of geostructures
- Soil-structure interaction
- Analysis and design of supported excavations
- Geotechnical earthquake engineering, soil liquefaction
- Advanced laboratory soil testing: residual, sedimentary, fly ash, biotreated sands
- Constitutive modeling of soils
- Static and dynamic stability of structures

Numerical simulations, advanced soil modeling

Advanced laboratory testing
Structural engineering future cities
Dr. Kevin Mackie, PE

- Advanced materials, accelerated construction
  - Composites and interfaces
  - In-situ repair
  - Accelerated construction, low maintenance

- Simulation and nonlinear analysis
  - Extreme hazards (earthquake, wind)
  - Designing for performance

- Reliability and uncertainty
  - Updating performance with sensor data
  - Decisions under uncertainty
Computational Structural Mechanics

Georgios Apostolakis

Computational Framework for Automated Design Cycle

MLF Temperature-Dependent Dynamic Thermoplasticity

Mixed Convolved Action (MCA) Layer Media Stress Wave Attenuation

Reduced Impedance Inserts

Stress Wave Shielding

MLF Temperature-Dependent Dynamic Thermoplasticity

Mixed-Lagrangian Formalism (MLF) Irreversible Thermoelasticity Laser Pulse Heating

Elastic Semi-Infinite Medium

Laser Pulse Train

Temperature

Displacement

Stress Response

Mixed Convolved Action (MCA) Layer Media Stress Wave Attenuation

Reduced Impedance Inserts

Stress Wave Shielding

Thermoplastic Model

Visco-plasticity

Elasto-plastic

Topography Damper Optimization

Regular & Irregular 3-D Structures

Computational Framework

Computational Framework for Automated Design Cycle
Geospatial Data Science
- Dr. Stephen Medeiros, PE

Encoding the Environment
- Mining Satellite and UAV Imagery, Laser Scanning Point Clouds, GPS, IoT sensor data using machine learning
- Actionable Information for model parameterization and validation, change detection, environmental and infrastructure monitoring
Department of
Civil, Environmental and Construction Engineering (CECE)

- Hydrology and Water Resources
  - Dingbao Wang

- Watershed hydrology
- Climate Change and Sea Level Rise impacts on Coastal Hydrology
- Water-Energy-Food Systems
Drinking Water Infrastructure Research at UCF

Summary: Dr. Duranceau’s research focuses on the quality of supply, treatment, distribution and storage of potable (drinking) water and its infrastructure, with specialized expertise in coastal and island water supplies. His research garners approximately $400,000 per year of funding that has generated 11 doctoral and 13 master degree graduates over the past decade. His applied water treatment operations studies fill an emerging need demanded in today’s increasingly complex municipal infrastructure climate that requires economic, social (health) and environmental multi-disciplinary approaches necessary to provide solutions to a number of challenging problems.

Funding Agencies (partial listing):
- Florida
  - City of Boynton Beach
  - City of Delray Beach
  - City of Sarasota Utilities
  - Jupiter Water Utilities
  - Orange County Utilities
  - Polk County Utilities
  - Sarasota County Utilities
- Georgia
  - Butts County Water & Sewer Authority
- California
  - Alameda County Water District
- Hawaiian Islands
  - County of Maui Water Supply (Maui)
  - Pulama Lanai Water (Lanai)
- Marianas Islands - Guam (U.S. Navy)
- Cayman Islands (Water Research Foundation)
- National Science Foundation
- U.S. Department of Agriculture

(Above) Another area of specialization is UCF’s drinking water research that involves the investigation of reverse osmosis desalination processes to treat brackish and sea water supplies.

(Above) Dr. Duranceau’s research team is recognized for their work related to internal and external corrosion of water distribution infrastructure.

(Above) Dr. Duranceau and two graduate students preparing to collect water samples at Fena Lake at the U.S. Naval Base on the island of Guam.

(Left) Dr. Duranceau’s research team is internationally recognized for their work related to drinking water quality and treatment.

Photo: UCF’s Operations Research Activities at Jupiter (FL) Nanofiltration Full-Scale and Pilot-Scale Process
Environmental Sustainability Assessment

Integrated Sustainability Assessment

Dynamic Life Cycle Costing and Environmental Analysis

Electric Vehicle Adoption Models

- S-EV
- S6PHEV
- S6HEV
- BAU

Total CO2 emissions from transportation:

- 750 M
- 500 M
- 250 M
- 0

Time (Year)

- 1980
- 1998
- 2015
- 2033
- 2050
Hydroenvironmental Systems Research

- Ni-Bin Chang

- Rule-based Decision Support Systems for Watershed Management and Drinking Water Infrastructure Assessment
- Stormwater Nutrient Control with Floating Treatment Wetland, Biosorption Activated Media, and other Best Management Practices
- Multi-Sensor Satellite Image Fusion, Data Mining, and Networking for Environmental Systems Analysis
Biotransformation of Biodiesel waste for Biological Nutrient Removal (advanced wastewater treatment) and other applications

Dynamic (empirical/process) and Metabolic (mechanistic/biochemical) modeling for Biological Nutrient Removal

Biotransformation and adsorption for Nutrient Removal from Stormwater

Graywater reuse

Water distribution system biostability

Cometabolism of chlorinated solvents
Microsensor Biofilm Research
Dr. Woo Hyoung Lee

- Needle-type Electrochemical Microsensors
- In Situ Monitoring of Engineered/Natural Aquatic Systems
- Biofilm Control
- Drinking Water Distribution Systems Nitrification
- Corrosion
- Kinetic Modeling
- Membrane Fouling
- Renewable Energy (Algae Biofuel, Biodegradable Plastics)
- Microbially Influenced Corrosion
- Wastewater Treatment Process
- Process Optimization

College of Engineering and Computer Science
University of Central Florida
Environmental Engineering: Membrane Treatment of Emerging Micropollutants

- Anwar Sadmani

- Optimization of the removal of “emerging” micropollutants (pharmaceuticals, personal care products, industrial additives) from surface waters within the context of the entire treatment train when using high and low pressure membranes

- Quantitative evaluation of membrane performance based on the composition of surface water to be treated and the physicochemical properties of target contaminants

- Investigation of the application and efficiency of forward osmosis and other membrane-based hybrid processes, in various combinations, treating impaired quality waters (focusing on the removal of micropollutants).
CHALLENGES: Landfill emissions must be controlled to ensure minimal environmental impacts. The residues left in landfills should not pose unacceptable risk to the environment.

CECS Research Facilities and State-of-the-Art Laboratories

Department of Civil, Environmental, and Construction Engineering (CECE)

- Smart Cities lab
- Microsensor Biofilm Research Laboratory
- Center for Hydroscience Analysis, Modeling, & Predictive Simulations
- Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS) instrument to be housed soon to strengthen cutting edge researches involving the analysis of trace level micropollutants in water
- Rainfall and sinkhole simulators
- Transportation Simulation Lab
Notable CECS Graduate Alumni

Department of Civil, Environmental, and Construction Engineering (CECE)

Isabel Escobar, **Professor**, Department of Chemical and Materials Engineering, University of Kentucky, Lexington, Kentucky
  • Center of Membrane Sciences Faculty: KY **National Science Foundation EPSCoR Membrane Pillar Faculty**

Nicole Berge, **Associate Professor**, Civil and Environmental Engineering Department, University of South Carolina, Charleston, South Carolina
  • **National Science Foundation CAREER grant recipient**

Dr. Sherif Ishak, Chair Civil Engineering Dept, University of Alabama

Dr. Xuedong Yan, Associate Dean, School of Transportation Engineering, Beijing Jiaotong University
Notable CECS Graduate Alumni

Anurag Pande, **Associate Professor**, Department of Civil Engineering, Cal Poly, San Luis Obispo, CA

Xuesong Wang, **Professor**, School of Transportation Engineering, Tongji University, China

Rongjie Yu, **Associate Professor**, School of Transportation Engineering, Tongji University, China

Mohamed Ahmed, **Assistant Professor**, Department of Civil & Env. Engineering, University of Wyoming

Albinder Dhindsa, CEO and founder, Grofers, On Demand Delivery Service for Indian Cities

Jeremy Dilmore, FDOT District 5, Head of ITS Office
CECS Graduate Students Entering the Workforce
Potential Jobs in Industry, Government and Academia

Department of Civil, Environmental, and Construction Engineering (CECE)

Employers of Graduates

Consulting/Design Firms  Universities
U.S. Geological Survey  Federal Highway Administration
National Oceanic and Atmospheric Administration  Departments of Transportation
DOE National Labs  Water and Wastewater Utilities
Water Management Districts  Federal and State Regulatory Agencies
CECS Editors and Associate Editors

Department of Civil, Environmental, and Construction Engineering (CECE)

- Ni-Bin Chang
  - Associate Editor, *Journal of Environmental Informatics*, Sept., 2006-today, published by the International Association of Environmental Information Management (ISEIS).
  - Associate Editor, *IEEE Systems Journal*, May, 2014 - present, published by the Institute of Electrical and Electronics Engineers (IEEE).

- Mohamed Abdel-Aty
  - Editor-In-Chief: Accident Analysis & Prevention
CECS Editors and Associate Editors

Department of Civil, Environmental, and Construction Engineering (CECE)

- Steven Duranceau
  - Associate Editor, Desalination and Water Treatment (Taylor and Francis)
  - Editorial Board Member, Membranes (MDPI).

- Haitham Al-Deek
  - Assoc. Editor: Journal of Intelligent Transportation Systems

- Debra Reinhart, Associate Editor
  - Waste Management

- Dingbao Wang
  - Guest Editor: Hydrology and Earth System Sciences
CECS Faculty Honors/Society Fellowships
Department of Civil, Environmental, and Construction Engineering (CECE)

- National Academy of Engineering
  - Nicholas Garber
- American Association for the Advancement of Science
  - Ni-Bin Chang, Debra Reinhart
- American Society of Civil Engineers
  - Necati Catbas, Ni-Bin Chang, Essam Radwan, Debra Reinhart, Ola Nnadi
- Early Career Honors
  - NAE Frontiers of Engineering; Necati Catbas (FOE-U.S.-Europe)
CECS University Honors

Department of Civil, Environmental, and Construction Engineering (CECE)

- **Trustee Chair**
  - Mohamed Abdel-Aty

- **UCF Pegasus Professors**
  - Mohamed Abdel-Aty, Debra Reinhart, Martin Wanielista (Emeritus)