Nick Machairas, Ph.D.

Geotechnical Engineer; Applied Analytics Professional

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A geotechnical engineer, lecturer and consultant that ventured into applied and predictive analytics, operating at the intersection of civil engineering and computer science. Areas of expertise include Machine Learning (small/local & large-scale/distrubuted), database management systems (relational & NoSQL), risk assessment, foundation design, instrumentation, load testing, A.I.-driven image analysis, collection and analysis of sensor and geotechnical data (IoT).

I help businesses transform their information to data and insights by designing and deploying custom software, databases, analytical procedures and business intelligence solutions.

Eager to remain at the forefront of the digital transformation of the Geoprofession, I apply advanced analytics to geotechnical engineering while working on next-gen processes for handling geotechnical data (ASCE G-I DIGGS), enabling A.I.-driven engineering design and risk assessment. I have been invited to train, write and present on this subject at conferences and the private industry.

Skills

Domain:	Data Engineering, Data Science, Geotechnical Engineering, Foundation Design, Higher Education
Strengths:	Deeply analytical, delivering insights by restructuring and analyzing 'messy' data, detail-oriented and time-efficient, comfortable working independently, known as the 'go-to' person in a team.
Modeling:	Plaxis 2D/3D, Ansys, Ensoft APILE/LPILE/GROUP/TZPILE, DeepEx, DeepFND, GRLWEAP, SAP2000, ETABS, SAFE
Programming:	Python (experienced developer), Matlab, R, Bash scripting, Git
Viz & B.I.:	Bokeh, Matplotlib, Seaborn, ggplot, PowerBI, Tableau, Metabase
Databases:	Data Warehousing & ETL, PostgreSQL, MySQL, MongoDB, Cassandra, Oracle, MS SQL Server
Big Data:	Apache Spark, Hadoop, Impala, BigQuery
Cloud Dev.:	Google Cloud, Amazon Web Services, Microsoft Azure
Web Dev.:	Flask, Django, PHP, HTML5, CSS3, JavaScript, Bootstrap, Bulma, Drupal, Wordpress

Formal Education

Ph.D., Civil (Geotechnical) Engineering (strong emphasis on Computer Science) — 2019
New York University — Brooklyn, NY
- *Assessment of Pile Design Methods Using Advanced Data Analytics* (Advisor: Dr. Magued Iskander)

M.Sc., Civil (Structural) Engineering — 2011
Columbia University — New York, NY

B.Sc., Civil Engineering *("magna cum laude")* — 2010
New York University — Brooklyn, NY

Work Experience

Founder, Principal — 2020 - present
Groundwork AI LLC — Brooklyn, NY
- We empower Geoprofessionals by incorporating Advanced Data Analytics and Machine Learning in their day-to-day activities, because our industry needs more agents of change. Our tailored data management and predictive solutions can lead to smarter, safer and more cost-effective infrastructure design and construction.

Independent Consultant — 2013 - 2019
Self — Brooklyn, NY
- Serving clients in a wide range of projects ranging from designing highly customized analytics applications to database design and implementation and geotechnical engineering consulting.

Online Graduate Program Manager and Course Developer, Systems Administrator — 2013 - 2019
New York University, Tandon School of Engineering, Department of Civil and Urban Engineering — Brooklyn, NY
- Overlooking, organizing, coordinating and leading the design and development of the first online graduate degree for the Department of Civil and Urban Engineering at NYU.
- Maintaining and operating multiple computer, server, database and telecommunications systems while supporting the faculty's individual teaching and research systems.

Partner — Sep 2013 - present
PMTE Construction Co. — Athens, Greece
- Upon my return to the United States, I remained as partner, acting as advisor while participating in the decision making process on the company's future plans.

(Work Experience continued)

Project Manager 2012 - 2013
PMTE Construction Co. Athens, Greece
- Running day-to-day operations of this family owned company
- Leading the design and construction of a variery of projects, from apartment buildings and villas to special projects such as radio station facilities and renovations of historic sites.
- Management of company owned real estate assets.

Superintendent 2002 - 2007
PMTE Construction Co. Athens, Greece
- Supervised master builders (carpentry, masonry) as well as iron workers, plumbers and electricians.

Teaching Experience

Lecturer, Applied Analytics Sep 2017 - present
Columbia University in the City of New York, School of Professional Studies New York, NY
- Course developer & lead instructor: Relational & NoSQL Databases, Data Warehousing & ETL, Machine Learning and Analytics in an Organizational Context

Adjunct Instructor Jun 2018 - present
New York University, Tandon School of Engineering, Department of Civil and Urban Engineering Brooklyn, NY
- Courses: Machine Learning, Computing in Civil Engineering, Principles of Professional Practice I-III (Ethics, Management, Leadership)

Competition Mentor 2016 - 2018
New York Academy of Sciences, Global STEM Alliance, The Junior Academy New York, NY
- "The Junior Academy is an elite group of problem solvers made up of talented students, STEM experts, and companies around the world dedicated to designing innovative solutions to global challenges."

Mentor summers 2014 - 2017
New York University, Applied Research Innovations in Science and Engineering (ARISE) Brooklyn, NY
- Top-rated mentor for this selective program for NYC junior high school students
- Among other topics, taught the Python programming language and geotechnical data processing and analysis algorithms. Inspired mentees for a possible career in STEM.

Teaching Assistant 2009 - 2016
New York University, Tandon School of Engineering, Department of Civil and Urban Engineering Brooklyn, NY
- Assisted in several courses as an undeargraduate and graduate student (Soil Mechanics, Advanced Foundations, Infrastructure Design), offering recitation and tutoring sessions.

Research Experience

Research Fellow: Ultimate Capacity of Driven Piles 2013 - 2019
New York University, Tandon School of Engineering, Department of Civil and Urban Engineering Brooklyn, NY
- P.I.: Dr. Magued Iskander, PE, F.ASCE
- Topic: "Modern Data Management and Analysis of Driven Piles"

Research Fellow: Environmental Design & Engineering 2017 - 2018
New York University, Tandon School of Engineering, Department of Civil and Urban Engineering Brooklyn, NY
- P.I.: Dr. Andrea Silverman
- Topic: "Comparison of Biological Weighting Functions Used to Model Endogenous Sunlight Inactivation Rates of MS2 Coliphage."
- Products: A peer-reviewed journal article [https://doi.org/10.1016/j.watres.2018.12.015]

Research Fellow: A.I.-driven Image Analysis 2016 - 2017
New York University, Tandon School of Engineering, Department of Computer Science and Engineering Brooklyn, NY
- P.I.: Dr. Nasir Memon
- Topic: "Intelligent algorithms that may rapidly identify children in sexual exploitation material in order to accelerate response time and rescue"
- Products: Extended existing training sets and compiled new by web scraping and organizing millions of images. Designed and tested multiple deep convolutional neural networks in a high performance computing environment.

Research Fellow: BiLab 2015 - 2016
New York University, Tandon School of Engineering, Department of Civil and Urban Engineering Brooklyn, NY
- P.I.: Dr. Semiha Ergan
- Topic: "Implementation of an operational intelligence system for the collection and analysis of building sensor data"
- Products: After coordinating with numerous vendors and IT managers, delivered a fully functional PI System (OSIsoft) collecting sensor data from multiple NYU buildings to be used by NYU researchers

(Research Experience continued)

M.Sc. Research Project Fall 2011
Columbia University in the City of New York, Civil Engineering and Engineering Mechanics New York, NY
- Advisor: Dr. Wilfried Laufs
- Topic: "Wired Structural Systems - Application to Lightweight Glass Facades"

Invited Lectures & Presentations

"Application of Dynamic Image Analysis for Sand Particle Classification Using Deep Learning", ASCE G-I Geo-Congress 2020, Minneapolis MN, Lectern Presentation, January 27 2020

"Evaluation of Pile Design Methods for Large Diameter Open-Ended Piles", Transportation Research Board (TRB) 99th Annual Meeting, Washington D.C., Lectern Presentation, January 13 2020

"Evaluation of Several Interpreted Pile Capacity Criteria for Large Diameter Open-Ended Piles", Transportation Research Board (TRB) 99th Annual Meeting, Washington D.C., Lectern Presentation, January 13 2020

"DIGGS Does Deep Foundations", DFI 44th Annual Conference on Deep Foundations, Chicago IL, Lectern Presentation, October 16 2019

"Advanced Data Analytics in Geotechnical Engineering", Geoprofessional Business Association (GBA) 2019 Fall Conference, Louisville KY, Invited Lectern Presentation, October 4 2019

"Processing Unlimited Data with Apache Spark", Predictive Analytics World for Government, Washington D.C., Invited Lectern Presentation, September 18 2018

"Advanced Data Analytics in Geotechnical Engineering", Invited lecture for Terracon employees, June 25 2018

"Interactive Web Application for Computing Seismic Earth Pressure", 5th Geotechnical Earthquake Engineering and Soil Dynamics (GEESD) Conference, Austin TX, Poster Presentation, June 11 2018

"An Investigation of Pile Design Utilizing Advanced Data Analytics", International Foundations Congress and Equipment Expo (IFCEE), Orlando FL, Lectern Presentation, March 8 2018

"Data Interchange for Geoenvironmental and Geotechnical Specialists (DIGGS) and Data Use in the GeoProfession", International Foundations Congress and Equipment Expo (IFCEE), Orlando FL, Lectern Presentation, March 8 2018

"Evaluation of FHWA Pile Design Method Against the FHWA Deep Foundation Load Test Database Version 2.0.", Transportation Research Board (TRB) 97th Annual Meeting, Washington D.C., Lectern Presentation, January 9 2018

Publications

(in review) Rizk, A., **Machairas, N.**, Kodsy, A., Iskander, M. (2021). "Efficacy of Design Methods for Predicting the Capacity of Large Diameter Open-Ended Piles" *ASCE Journal of Geotechnical and Geoenvironmental Engineering*

(in print) Kodsy, A., **Machairas, N.**, Iskander, M. (2021). "Assessment of Several Interpreted Pile Capacity Criteria for Large Diameter Open-Ended Piles" *ASTM Geotechnical Testing Journal*

(in print) Rizk, A., **Machairas, N.**, Iskander, M. (2021). "Evaluation of Several Design Methods for Calculating Axial Compression Capacity of Large Diameter Open-Ended Piles (LDOEP)" *IFCEE 2021*, May 10-14 2021, Dallas, TX

Machairas, N., and Iskander, M. (2020). "Advanced Data Analytics in Geotechnics." *Geostrata*, American Society of Civil Engineers, 24(4), 32–39. [https://www.readgeo.com/geostrata/july_august_2020]

Bachus, R., **Machairas, N.**, and Cadden, A. (2020). "Standardizing Geodata Transfer and Storage." *DFI Deep Foundations Magazine*, (May/June 2020), pp 97–100. [http://dfi.dcatalog.com/v/May-June-2020/]

Machairas, N., Li, L., Iskander, M. (2020). "Application of Dynamic Image Analysis for Sand Particle Classification Using Deep Learning" *ASCE G-I Geo-Congress 2020, Minneapolis MN* [https://ascelibrary.org/doi/10.1061/9780784482803.065]

Bachus, R., **Machairas, N.**, and Cadden, A. (2019). "DIGGS Does Deep Foundations." *DFI 44th Annual Conference on Deep Foundations*, Deep Foundations Institute [http://www.dfi.org/pubdetail.asp?id=3269]

Silverman, A. I., Tay, N., and **Machairas, N.** (2018). "Comparison of Biological Weighting Functions Used to Model Endogenous Sunlight Inactivation Rates of MS2 Coliphage." *Water research*, 151, 439–446. [https://doi.org/10.1016/j.watres.2018.12.015]

[1]**Machairas, N. P.**, Iskander, M. G., and Omidvar, M. (2018). "Interactive Web Application for Computing Seismic Earth Pressure." *Geotechnical Special Publication 292*, M. M. T. Brandenberg S.J., ed., American Society of Civil Engineers (ASCE), 398–406. [https://doi.org/10.1061/9780784481479.041]

[1]URL for SEP Calculator: https://wp.nyu.edu/sep/calculator/

(Publications continued)

[2]**Machairas, N. P.**, and Iskander, M. G. (2018). "An Investigation of Pile Design Utilizing Advanced Data Analytics." *Geotechnical Special Publication 294*, S. M. T. Stuedlein A.W. Lemnitzer A., ed., American Society of Civil Engineers (ASCE), 132–141. [https://doi.org/10.1061/9780784481578.014]

Machairas, N. P., Highley, G. A., and Iskander, M. G. (2018). "Evaluation of FHWA Pile Design Method Against the FHWA Deep Foundation Load Test Database Version 2.0." *Transportation research record*, SAGE Publications Ltd. **2018 Best Paper Award** [https://doi.org/10.1177/0361198118773196]

Bachus, R., Cadden, A., and **Machairas, N.** (2018). "DIGGS Does Pipelines." *Pipelines 2018*, American Society of Civil Engineers (ASCE), 281–289. [https://doi.org/10.1061/9780784481660.031]

Baamer, M., Suescun-Florez, E., **Machairas, N.**, and Iskander, M. (2015). "Strain Rate Dependency of Sand Response under Uniaxial Monotonic Loading." *IFCEE 2015*, American Society of Civil Engineers, Reston, VA, 171–181. [https://doi.org/10.1061/9780784479087.018]

Leadership

Advisory Member / Task Force — Sep 2020 - present
ASCE G-I Innovative Technologies and Tools in Geotechnical Engineering (INNC) — National - USA

Member — Mar 2020 - present
TRB AKG70 Standing Committee on Foundations of Bridges and Other Structures — National - USA

Secretary — Jan 2019 - present
ASCE Metropolitan Section, International Group — New York, NY

Member — Dec 2018 - present
ASCE G-I Deep Foundations Committee — National - USA

Member, Contributor — Jan 2017 - present
ASCE G-I Data Interchange for Geoenvironmental and Geotechnical Specialists (DIGGS) — National - USA

Member — May 2017 - present
The United States Universities Council on Geotechnical Education and Research (USUCGER) — National - USA

Vice President — 2015 - 2018
The East Mediterranean Business Cultural Alliance (EMBCA) — New York, NY

Student Activities Co-Chair — 2016
Deep Foundations Institute (DFI), 41st Annual Conference — New York, NY

Member — 2014 - 2015
Hellenic-American Chamber of Commerce, Development Design & Construction Committee — New York, NY

Relevant Projects

[3]**edafos: A Python Module for Soil Mechanics** — ongoing
- Technologies: **Python, Sphinx**
- Outcomes: Author of a first-of-its-kind Python module. Enabled batch-processing of complex engineering analyses for the probabilistic design of foundation elements.

[4]**DIGGS: A GML Geospatial Schema for the Transfer of Geotechnical & Geoenvironmental Data** — ongoing
- Technologies: **XML, GML, Python**
- Outcomes: Active developer and subject-matter expert on the national committee defining the standards and best practices for proper data management and distribution for geoprofessionals. Working with software vendors to implement said data standards.

NYU Pile Capacity (http://pilecapacity.com) — Oct - Dec 2019
- Technologies: **Python, Docker, Postgres, Flask, HTML, JavaScript**
- Outcomes: Designed a multi-schema relational database and the data injestion processes of extremely complex and messy engineering, sensor and lab testing data. Developed a Python Flask web application for user friendly interaction as well as analytical procedures delivering insights reducing risk and cost of construction.

Real-time Student Performance Visualization & Analytics — Jun - Aug 2018
- Technologies: **Python, Postgres, Flask, Tableau**

[2]URL for Pile Capacity Calculator: http://cue3.engineering.nyu.edu:5012/ifcee2018_predict
[3]Repository for edafos: https://github.com/nickmachairas/edafos
[4]Repository for DIGGS: https://github.com/DIGGSml/diggs-schema

(Relevant Projects continued)

- Outcomes: Developed an application that aggregated student scores and delivered real-time updates to faculty. Built interactive visualizations of student performance on Tableau.

Web Scraping & A.I.-driven Image Analysis Apr - Jun 2017
- Technologies: **Python, Tensorflow, SCRUM (High-Performance Computing)**
- Outcomes: Compiled new training datasets by web scraping millions of images. Designed and tested deep convolutional neural networks in a high performance computing environment. Must note that this project was initially designed to be deployed on Google Cloud but client chose on-premise.

Operational Intelligence System for the Collection and Analysis of Building Sensor Data Jun - Nov 2016
- Technologies: **MS SQL Server, BACnet, OSIsoft PI System, Apache Hadoop & Spark**
- Outcomes: Designed and implemented a PI System (OSIsoft) collecting data from over 2,000 sensors. Delivered the infrastructure to facilitate wide-range predictive analytics on Apache Hadoop & Spark.

Professional Education & Career Development

Massachusetts Institute of Technology (MIT) Cambridge, MA
Short & Digital Programs, Experimental Learning Spring - Fall, 2016
- *Data Science: Data to Insights; Big Data and Social Analytics; Data and Models in Engineering, Science, and Business; Internet of Things: Roadmap to a Connected World; Tackling the Challenges of Big Data*

The New York Academy of Sciences New York, NY
Science Alliance Leadership Training (SALT) summer 2016

edX & Coursera online
certificates for 20+ MOOCs (focus on Computer/Data Science and Data Engineering) 2014 - present

Awards & Scholarships

- [5]**Best Paper Award**, Machairas, N. P., Highley, G. A., and Iskander, M. G. (2018). "Evaluation of FHWA Pile Design Method Against the FHWA Deep Foundation Load Test Database Version 2.0."
- **Geo-Institute Graduate Scholarship**, ASCE Met Section, 2017
- **Underground Construction Association of the Society for Mining, Metallurgy, and Exploration (UCA of SME) Scholarship** for RETC, 2017
- **Graduate Scholarship Recipient**, The International Association of Foundation Drilling (ADSC), 2016
- **Magna Cum Laude**, top 15% of graduating class, B.Sc., Civil Engineering, 2010
- **The Moles Scholarship**, top undergrad in geotechnical courses, 2010
- **Theodor Clinton Towl Award**, awarded to outstanding seniors in civil engineering, 2010
- **Promise partial-tuition scholarship**, awarded in recognition of academic merit and leadership, 2008 - 2010
- **Dean's List**, in recognition of scholastic excellence and achieving a GPA of 3.4 or higher, 2008 - 2010
- **Society of American Military Engineers Award and Scholarship**, in recognition of outstanding academic achievement, 2009
- **Chi-Epsilon Member**, The National Civil Engineering Honor Society, 2009
- **Tau Beta Pi Member**, The National Engineering Honor Society, 2009

[5]Media coverage: `https://bit.ly/2QbGbFv`