BRANDON BENTON, PhD

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COMPUTATIONAL RESEARCH SCIENTIST

Data Science – Machine Learning – Software Development – Physics Based Modelling – Applied Math

SUMMARY

Consistent record of achievement in the areas of data science, machine learning, physics, and computer modeling. Multiple publications and presentations relating to climate modeling, data visualization, virtual reality development, aerodynamics, condensed matter, and fluid dynamics. Special expertise in experimental design, development, and execution. Additional experience instructing physics and mathematics classes for undergraduates, overseeing graduate student research programs, and creating algorithms and prototypes.

Key Competencies:

Data Science – Machine Learning – Software Engineering – Data Analysis – High Performance Computing – Research – Aerodynamics – Fluid Dynamics – Meteorology – Climate Modeling – Computational Modeling – Virtual Reality – Prototyping – Programming Database Design – Simulations – Statistical Analysis – Process Improvement – Problem Solving

TECHNICAL SKILLS

Development Tools: Python, Jupyter, SQL, Bash, C++, NumPy/SciPy, Mathematica, Scikit-learn, Git, PySpark, TensorFlow, Keras, Pandas, Matplotlib, NLTK, Java, HTML, Fortran, CUDA, JavaScript, MATLAB, R
Platforms: UNIX, ROS, Windows, Gazebo
Software: MS Office, OpenFOAM, CESM, WRF
Methodologies: High performance computing, machine learning, data visualization, NLP, algorithms, numerical modeling, mathematical modeling, linear algebra, differential equations, signal processing, statistical analysis, probability, scientific computation

PROFESSIONAL EXPERIENCE

CORNELL UNIVERSITY, Ithaca, NY 2020 – Present

Post-Doctoral Fellow

Designed and carried out research in the areas of climatology, weather patterns, and COVID modelling. Relied on extensive experience with big data, machine learning, software development, statistical analysis, and modelling.

Projects:

Climate AI:

Image classification – Computer vision – python – TensorFlow – Keras

- Developing tools for detecting hurricane conditions in satellite images.

Climate Modelling:

Cloud-based development – python – modelling

- Developing an AWS interface to allow the general public to perform climate simulations. Grant provided by the Carl Sagan Institute.

Weather Forecasting:

Big Data – python – modelling – cloud-based development – applied math – education

- Developing and planning a hyperlocal weather forecasting system designed to improve winter-storm emergency response and enhance natural disaster coordination for New York state's rural communities.
- Developed python code to setup WRF on AWS and a post-processing environment on Amazon Workspace. Led team of undergraduate students using this code to perform on-demand weather forecasting for Tompkins County.

Aqua-planet Simulations:

Cloud-based development – cluster deployment – python – fortran – modelling

- Led research on the effect of heat anomalies injected into aqua-planet SSTs on the polar vortex. Ran aquaplanet simulations on Cheyenne Supercomputer using CESM.

COVID Modeling:

Big Data – cloud-based development – python – modelling – applied math

- Built custom compartmental infectious disease model including asymptomatic, symptomatic, hospitalization, and death projections for the entire United States. Social distancing included along with gradient descent-based parameter estimation.
- Model hosted on AWS and constantly updated using CovidTracking API.

Low Frequency Climate Variability in Tree Rings:

Big data – python – MATLAB – modelling – statistical analysis

- Updated and improved a complex database of tree ring information from a variety of disparate, obscure, and hard-to-access data sources.

CORNELL UNIVERSITY, Ithaca, NY 2013 – 2019

PhD Researcher

Designed and carried out research in the areas of climatology, weather patterns, virtual reality interface design, and aerodynamic sound modeling. Relied on extensive experience with Big Data, software development, statistical analysis, and modelling.

Projects:

Low Frequency Climate Variability in Tree Rings:

Performed multi-taper Fourier and singular value decomposition analysis on chronologies to detect and reconstruct climate signals.

Big data – python – MATLAB – modelling – statistical analysis

- Developed successful code to construct and de-trend tree ring chronologies from various data sources.
- Built the first comprehensive tree ring chronology database, to facilitate the detection and reconstruction of climate response signals.

Effect of Volcanic Eruptions on Hurricanes:

Analyzed the effect of volcanic eruptions on hurricane intensity, life span, and frequency.

Big data – python – CESM – WRF – modelling – statistical analysis

- Led the largest (temporally and spatially) downscaling of global circulation model data, spanning 1,000 years of climate data and encompassing the Atlantic ocean and continental US.
- Produced and analyzed 20TB of raw data from high-resolution coupled atmosphere-ocean regional climate simulations with focus on hurricane statistics.
- Created the code to parallelize annual downscaling of global circulation model data.
- Improved efficiency by automating the storage, cleaning, and compression of the dataset.
- Submitted results for publication, demonstrating minor effects of volcanic eruptions and hurricane statistics.

Virtual Reality Quadcopter Interface:

Designed a comprehensive plan for constructing a virtual reality interface for unmanned aerial vehicles.

Python – C++

- Utilized 3D spatial reconstruction from sparse sensor data to resolve bandwidth and latency issues.

First-Person Aerodynamic Sound:

Developed an algorithmic approach for producing first-person aerodynamic sound in real time, with a goal of utilizing the algorithm for virtual reality applications.

Python – C++ – OpenFOAM

- Modeled air flow around a human head using computational fluid dynamics software.
- Investigated the feasibility of particle-based fluid modeling operating on GPUs coded in CUDA to generate aerodynamic sound, and used MATLAB to generate sound using autoregressive stochastic models.

Aerodynamics of Maple Seeds:

Analyzed the aerodynamics of falling maple seeds, using analytical and experimental procedures to create a physical model, with the goal of applying insights to miniature drone flight performance.

Python – C++ – MATLAB

- Developed empirical models using computer vision techniques in the laboratory.

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ADDITIONAL EXPERIENCE

BRANDON BENTON, Ithaca, NY 2012 – Present
Independent Researcher
Developed and carried out data science, aerodynamics, engineering, and physics research.

- Designed and built a working quadcopter with GPS-enabled navigation, remote control capability, and computer control interfaces.

NLP – python – NLTK – scikit-learn

- Developed a Twitch bot to filter offensive content in channels. Bot trained on chat data classified based on messages being timed out or not. Bot achieved 98% success rate and is currently in use on a Twitch channel.

GEORGIA SOUTHERN UNIVERSITY, Statesboro, GA 2009 – 2013
Undergraduate Researcher
Conducted research and experimentation in physics. Performed numerical modeling.

- Studied Bose-Einstein condensate systems undergoing various dynamics.
- Modeled expansion, pulsed laser response, and confinement behavior of condensate systems.
- Published 3 papers in professional journals and presented on results at NIST and DAMOP conferences.

EDUCATION

PhD in Physics, Cornell University, Ithaca, NY (2019)

- **Thesis:** "Analysis of Low-Frequency Climate Variability through Computational Modeling and Tree-Ring Data Synthesis."

MS in Physics, Cornell University, Ithaca, NY (2016)

- **Thesis:** "Virtual Reality Quadcopter Telepresence Proposal."

BS in Physics, Georgia Southern University, Statesboro, GA (2012)

- Graduated *magna cum laude;* completed University Honors Program.

SUPPLEMENTAL INFORMATION

***Certificates*:**

- IBM Data Science Specialization
- Stanford Online Algorithms Specialization
- IBM Advanced Data Science Specialization
- IBM Applied Data Science Specialization

Publications:

- Evans, C, Ault, T, **Benton, B,** Carillo, C, Coats, S, and Herrera, D; "Intrinsic century-scale variability in tropical Pacific SSTs and their influence on western US hydroclimate," Geophysical Review Letters, submitted, July 2021.
- **Benton, B,** Herrera, D, Li, X, Allesi, M, and Ault, T; "Minor impacts of major volcanic eruptions in dynamically-downscaled last millennium ensemble data," Climate Dynamics, submitted, April 2021.
- Edwards, M, Krygier, M, Seddiqi, H, **Benton, B,** and Clark, C; "Approximate mean-field equations of motion for quasi-2D Bose-Einstein condensate systems," Physical Review E, 86(5), November 2012.
- **Benton, B,** Krygier, M, Heward, J, Edwards, M, and Clark, C; "Prototyping method for Bragg-type atom interferometers," Physical Review A, 84(4), October 2011.
- Edwards, M, **Benton, B,** Heward, J, and Clark, C; "Momentum-space engineering of gaseous Bose-Einstein condensates," Physical Review A, 84(4), December 2010.