BENJAMIN ETHAN COWEN

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EDUCATION

New York University, Tandon School of Engineering (Brooklyn, NY)
Doctorate in Electrical Engineering (GPA = 3.825) May 2019

Case Western Reserve University (Cleveland, OH)
Master of Science in Applied Mathematics (GPA = 3.667) May 2015
Bachelor of Science in Applied Mathematics, Physics Minor (GPA = 3.533) May 2014

SKILLS

Python (PyTorch, PyAudio), Matlab (CMEX), C++ (OpenCV), Lua (Torch7), CUDA, Linux/Ubuntu bash, CMake, bazel, docker, Test driven development (TDD), remote development (Git). Convex analysis, numerical optimization, linear algebra.

RESEARCH EXPERIENCE

New York University, Tandon School of Engineering Department of Electrical and Computer Engineering
Research Assistant under Ivan Selesnick, Ph.D and Anna Choromanska, PhD. Aug 2015-Present
Designed and implemented digital signal/image processing algorithms in MATLAB and Python, with deep learning in Torch and PyTorch.

- ***"Beyond Backprop: Online Alternating Minimization with Auxiliary Variables"*** submitted to ICML 2019, available on Arxiv.
  - Developed and implemented an alternating-minimization scheme in PyTorch for training neural networks, an alternative to standard backpropagation algorithms.
  - Collaborated with an AI research team at IBM's TJ Watson Research Center.
- **"*LSALSA: efficient sparse coding in single and multiple dictionary settings*"** submitted to ECML-PKDD 2019, available on Arxiv.
  - Devised, implemented, and trained novel recurrent deep-learning architectures for sparse coding using Lua and PyTorch.
  - Provided theoretical insight into the meaning of our "learned algorithm", and derived mathematical conditions for the convergence of this algorithm.
  - Accelerated an ADMM-type algorithm by orders of magnitude without reducing quality of the solutions.
  - Demonstrated fast source separation in images (separating numerals from natural images).
- **"*Vector minimax concave penalty for sparse representation*",** DSP Vol 83, Dec 2018 pg 165-179.
  - Designed sparsifying non-convex penalty/regularization functions that outperform the L1 norm (MATLAB).
- **"*Phenomenology Based Decomposition of Sea Clutter with a Secondary Target Classifier*"** accepted as a presentation at 2017 IEEE Radar Conference (then withdrawn).
  - Investigated and developed signal detection and separation models with an oceanic radaar expert (MATLAB).
  - Applied similar schemes for deconvolution in multi-channel underwater acoustic signals (SONAR).
- ***"Enhanced Overlapping Group Sparsity for Speech Signal Processing"*** work in progress (in MATLAB).
  - Derived and implemented nonlinear filter algorithms to process human speech signals (denoising, inpainting).
  - Mathematically modeled and exploited natural speech structures in the time-frequency domain to reduce 'musical noise'.
  - Maintained convexity of the inverse problem while exploiting non-convex regularization, outperforming the L1-norm.
  - Experimented with similar schemes for inverse problems in imaging and source separation.
- ***"Spike-and-Wave Complex Detection in Intracranial EEG",*** work in progress.
  - Implemented a multi-function GUI in MATLAB for visualization, annotation, and detection of data stored in European Data Format (.edf)
  - Collaborated with a neurologist to detect and analyze clinically relevant waveforms.
- ***"Mass Spectrometry Signal Processing for Metabolomics"***, work in progress.
  - Collaborated with medical experts to develop mass spectrometry peak analysis software (Python and MATLAB).

Teacher's assistant for "Signals and Systems", a core course for engineering students. Aug 2016 – May 2017

- Autonomously taught the laboratory section of this Junior-level engineering core course.
- Created lab sessions from scratch to illustrate principals of time-frequency analysis and image processing.

NVIDIA Corporation (Holmdel, NJ)
Software Engineering Intern - Autonomous Vehicles (C++, Python, CUDA, Git, CMake, docker, bazel, Linux) May-Aug 2018
Designed and implemented software for deep learning training pipeline, focused on test-driven-development and image augmentation.

- Formulated and implemented experiments to measure the accuracy of digital perspective transforms
  - Implemented image analysis and visualization tools from scratch in C++ to work in tandem with OpenCV.
- Refactored data augmentation pipeline, including design and implementation of comprehensive unit tests.
- Developed and documented camera extrinsics calibration procedure. Contributed to embedded app on Drive-PX2

Case Western Reserve University Department of Mathematics, Applied Mathematics, and Statistics
Research Assistant under Weihong Guo, Ph.D. March 2014-May 2015, Summer 2016
Designed and implemented a variational/PDE-based image reconstruction algorithm for parallel MRI in MATLAB.

- **"*Bregman Operator Splitting with Variable Stepsize for TGV based Multi-channel MRI Reconstruction*"**, thesis online.

- Derived and implemented algorithm for multi-channel MRI reconstruction in MATLAB.
- Synthesized techniques from multiple cutting-edge algorithms, including adaptive stepsize selection and the high order smoothness prior "total generalized variation" (TGV).

OptoQuest (Cleveland Clinic, Cleveland, OH)
Research and Design Engineer May 2014-August 2015

Designed and implemented data pipeline that generates 3D coordinates from volumetric optical coherence tomography (OCT) images, and prepares them for input to finite element models and ray-tracing software.

- Customized a segmentation algorithm based on dynamic programming in C/MEX
- Implemented Ray Tracing simulation and wavefront analysis software library in Python. Designed optical model of human eye.
    - Renders 3D visualizations and provides clinically relevant analyses of wavefront properties.

LEADERSHIP & VOLUNTEER EXPERIENCE

- Awarded Ernst Weber Fellowship from NYU Tandon School of Engineering. Four years of complete funding and stipend. Nominated by Ivan Selesnick, PhD.
- Reviewer for ICML, NeurIPS, ICLR, AISTATS (2018), and ICML, NeuRIPS (2019).