Resume

Mitch Nelson

Applied Sciences, Embedded Devices

Firmware and Electrical Engineering

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Scientific Background

Optics, Acoustics, Materials, Organic Electronics, Chemical Physics, Physical Chemistry, Spectroscopy, physical theory and analysis, numerical modeling.

Engineering Skill Set

Firmware, C, assembler, C++, Python, micro-controller (ARM, AVR, STM32, NXP), TI DSP, Linux device drivers, graphics and user interface, signal and image processing.

PCB design, schematic capture, low noise analog and low noise mixed analog-digital circuits and layout, high precision ADC, DAC, voltage and current measurement inputs and waveform generation, CCDs, photodiodes, transducers, motors, piezoelectrics, TEC, temperature, DSP, USB, Ethernet, SPI, PCI, I2C, PCI, parallel, serial.

Electrical assembly (TH and SMT) and test, 3-D design, 3-D printing and CNC.

Resources, Laboratory and Prototyping

Assembly and test facilities for analog and analog-digital designs (both SMT and TH), ICE; Lab supporting studies in optics, acoustics, spectroscopy, opto-electronics, imaging, kinetics, custom instrument and sensor development, device characterization, custom transducer and sensor system development, holographic imaging; mechanical prototyping with 3d-printer and CNC for opto-mechanical and acoustic lensing assemblies.

Work samples, projects and contributions available online

[Linear-CCD (a tutorial) with LTSpice, KiCAD, Firmware and Python Library](#)

[The SPI Instrumentation project, overcoming barriers to doing great science in an underfunded lab](#)

[Reseach publication: Stimulated emission in OLEDS](#)

<div align="center">**Experience**</div>

Independent consultant

Providing design services and guidance for embedded systems including mixed-signal design, firmware, software, user interface, optics, acoustics, instrumentation, controls, devices and applications, patents, prototyping, and manufacturing.

Sample projects:

1. The SPI Instrumentation Project – Low cost professional class instrumentation enabling high-end science for underfunded scientists. Implemented in circuits, devices and firmware for Arduino/Teensy/Raspberry with host-side software in Python/C++.

2. Air-sonar system, detecting, recognizing and locating drones in 3-d at 1km.

3. High performance, multi-function micro-controller (ARM7) enabled spectrometer, implemented as 2-board set, linear CCD and controller, with a special purpose analog front end, precision ADC (SPI), and programmable auxiliary analog and digital I/O. The design was optimized to be competitive in performance, features, cost and volume manufacture in the current supply chain environment.

4. Semiconductor characterization station, multi-function micro-controller (AVR) based DAQ (6 layer PCB design), with generation and high precision recording of analog waveforms and ultra low currents, trigger and gate interfaces, programmable digital I/O, built in functions for motor drive, temperature control, integration with linear CCDs, cameras, spectrometers, firmware in C, host software in Python providing graphical and command line interfaces and scripted automation.

5. Electrostatic air-borne particle counter with characterization by size, mass and UV-Vis spectrometry. Microcontroller based with innovative compact and low cost ion optics.

6. Volatile organic chemical sensing with improved sampling, mass spec and machine learning for medical diagnostics. Developed an improved model of gas diffusion in alveoli followed by the first ever reproducible sampling technique for biological VOCs.

7. Ocean acoustics research systems (several), circuits, transducers, firmware, imaging array, designed to operate for several weeks on battery power at depth 200m.

Organophotonics, 2014-present

Research in organic electronics, production of laser light by direct electrical excitation in organic light emitting diodes. First report of continuous stimulated emission in an OLED, and first report of stimulated emission in a solid state device at low current density (50 $\mu A/cm^2$) compatible with large scale integration.   Developed a hyper-spectral imaging system with temperature control and automation to observe stimulated emission as it emerges at low current densities (order 10 $\mu A/cm^2$). Discovery of pseudo-temperature and related effects in

organic lasing materials. Authored papers, patents, proposals, presented work at international conferences.

Material intelligence, LLC, 2004-2013

Director. Developed acoustic holographic imaging systems and AI based object recognition in a multi-layer architecture spanning custom sensors, transducers, HV pulse drivers, mixed analog-digital design, signal acquisition,signal and image processing, TI DSP, and desktop and laptop user interfaces. Supervised a term of 6 engineers, led a collaboration of mathematicians and scientists, authored successful funding proposals for government programs and investors.

Datatek Applications, LLC. 2000-2004

Director for special projects, supervised a team of 50 engineers and support staff designing products for telecommunications.

DSPCon, 1998-2000

Engineer. TI DSP firmware and bring-up, systems for DAQ, acoustics, flight training, video distribution, 5 product roll-outs.

University of Illinois

Research Faculty. Developed data acquisition electronics and software, x-ray diffraction, spectroscopy and research in dynamical diffraction, advanced materials.

Education

Post-doctoral Fellowship Frederick Seitz Materials Research Laboratory, University of Illinois, Urbana-Champaign; National Synchrotron Light Source, Brookhaven National Laboratory

Post-doctoral Fellowship BNL Chemistry, NSLS

Ph.D. Chemical Physics, State University of New York, Stony Brook

B.Sc. Chemistry, University of Delaware

Selected Publications

1. Nelson, MC and Rothberg, LJ. Stimulated Emission in Long Cavity OLEDS. *Proc. Optical Probes*, 10-15 Sept 2023, Lake Como (Invited speaker); https://op2023.eu/images/Book_Abstract-compressed.pdf

2. Nelson, M. Low onset stimulated emission in OLEDS, *Proc. SPIE 12208, Organic and Hybrid Light Emitting Materials and Devices XXVI*, 1220809, 3 October 2022; doi: [10.1117/12.2634247](10.1117/12.2634247)

3. Nelson, MC; Rothberg, L; Wieczorek, M. Low Onset Stimulated Emission in Electrically Pumped Organic Light-Emitting Diodes, *ACS Photonics* 2022, 9(2), 511-517. https://doi.org/10.1021/acsphotonics.1c01300

4. Nelson, MC, Rates and singlet/triplet ratios from TADF transients, arXiv:1603:08998 [physics.chem-ph] (2016)

Selected Patents

1. Low Onset Gain Saturation OLED, Inventor: Mitchell C Nelson, US20200106052A1

2. System, Device, And Method For Detecting And Characterizing Explosive Devices And Weapons At Safe Distances. Inventor: Mitchell C Nelson, US 7319233 B2

3. Detection, Location, and Characterization of Buried Explosive Devices and Weapon Caches. US 20070152866 A1

References

Provided upon request.