Nelson Research, Inc. Craig E. Nelson Consultant Engineer
2142 - N. 88th St. Seattle, WA 98103 (206) 498 - 9447 craig@nelsonresearchinc.com

To Whom It May Concern,

I am an electronic, mechanical, ultrasound, biomedical, NDT, electro-optical, sensor engineer and occasional project manager with many years of experience designing high performance transducers, high peak power pulsers, switchmode power supplies, broadband receivers, electro-physical actuators and micro-fluidic devices, as well as complete systems of various kinds. I have many years experience designing, analyzing and making ultrasonic and acoustic measurements on materials, transducers and systems. I am an experienced RF-Analog circuit designer.

Also, I have a fairly well equipped electronic, ultrasound, microwave and electro-optics laboratory. The on-hand instrumentation includes network analyzers, spectrum analyzers, an automated acoustic scanning tank with angular positioning, digitizing oscilloscopes and a rather wide assortment of pulsers, preamplifiers, transducers and so on. To help out with general device and material measurement support requirements, I also have a modest machine shop with a lathe, mill and related jigging, cutting tools and measuring instruments.

I hope that, after review of my resume, an opportunity to discuss how I can help your company with its work will be offered.

Sincerely Yours,

Craig E. Nelson

Engineer

Craig E. Nelson - Engineer

Objective:

To use my applied science, engineering and-or small team management abilities as part of an aggressive effort directed at accomplishing difficult and specific technical goals.

Qualifications:

- Many years experience as a "hard-core-at-the-bench" electronic, electromechanical, optical, fluid-mechanical, micro-fluidic, electro-chemical, microwave and ultrasonic circuit, transducer and system design engineer
- 4 years experience as chief engineer for a very successful biomedical startup – Advanced Technology Laboratories – Bellevue, WA
- Many years experience as founder and president of a startup selling specialized ultrasound measuring instrumentation into the US, Japan and Europe. NTR Systems, Inc. – Seattle, WA. These systems comprised custom NC positioning devices, hydrophone transducers and electronics
- Six years as project manager and principal electronic designer for ultrasonic cardiac output and fetal heart monitors – SpaceLabs Medical
- Seven years experience designing micro-fuel cells – I designed numerous microfluidic and electromechanical devices - Neah Power Systems, Inc.
- Breakthrough medical ultrasound imaging systems I designed and project managed have been on display (temporarily) in the Smithsonian

"Expert" Level Technical Skills and Knowledge Base:

- RF- Analog - Digital electronic circuit, system and instrumentation design – I am a very experienced RF-Analog circuit designer
- Switchmode Power System design-developed 1 kw DC-AC power inverters and high peak pulse power transducer driver circuitry
- Piezoelectric, electro-mechanical and various other electro-physical transducer device design - many years of hands-on experience
- Ultrasonic, acoustic and switch-mode power conversion circuit and system design - I have done a lot in these areas
- Acoustic and ultrasonic transducer, system and materials characterization, design and analysis – many years of hands-on experience
- Electromagnetic and microwave material characterization systems - I have an RF-microwave NDT materials testing lab (good to 18 GHz)
- Design engineering of electro-chemical test cells and related half and full cell electrode measurements (including EIS) methods
- Micro-fluidics and related devices (I designed and tested a series of piezo and micro-motor driven micro-pumps and micro-valves)
- I have FEA computer modeled many micro fluidic devices. One was a mixed phase (liquid-gas) flow system with variable gas fraction
- Material characterization of MEMS devices by non-contacting methods - Designed-built-used RF eddy current and microwave systems
- General fluid-mechanics and electro-mechanics from meso to macro dimensions – this is current and ongoing work
- Electro-optics – I have designed several sophisticated optical systems and devices – I have my own small but effective electro-optics lab
- Designed acousto-optic modulator; infrared illuminator; wideband water submersible photo detector; Michelson interferometer; laser welder
- Analyzed servo feedback control of complex systems and mechanisms using PID controllers, complex plane analysis and other methods
- FEA modeled mass transport to and away from electro-chemical electrode systems – tested skin abrasion as a way to enhance EKG electrodes
- Thermal, electromagnetic, structural and acoustic field modeling (FEA - multiphysics) - I have developed about a hundred FEA models
- Instrument and data acquisition control systems software development (Labview) – this work is new for me - more of this is welcome!
- Statistical analysis and signal processing – I have completed many tasks in this area. Recently I analyzed "Bubble Noise" in a fuel cell
- SolidWorks – I use it every day MathCAD- Multisym – primary tools for me Matlab – occasional use MS Office – a way of life
- Hands on lathe, mill, machine shop tools and various other industrial manufacturing practices including a little MEMS technology

Established Administrative Skills and Experience Base:

- Proposal writing, design presentations – interaction with vendors - Capital and operations budgeting and financial forecasting
- Technology and product development program projectization using PERT, Gantt and other planning and tracking methods

Education and Work History: **Please see the next page**

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Education and Work History:

1966-1970 BSEE (under graduate - circuits and systems): University of Washington (Seattle, WA) Ham Radio Operator

1970-1972 Junior Engineer (RF-analog circuit designer - HF band chirp CW radar): Barry Research (Palo Alto, CA)

1972-1975 MSEE (graduate student - Signal Processing and System Theory): U of Washington (Seattle, WA)

1973-1975 RF Engineer – I designed signal processing and circuits for the worlds' first Duplex Doppler ultrasound scanners, implantable RF telemetry systems (UW Bio-eng. Dept.); Designed-built-debugged an ultra high dynamic range submarine warfare dataq system: (UW-APL); I set up and got going a 1.4 GHz Dicke Radiometer microwave receiver (UW-Astronomy Department)

1975-1980 Chief Engineer – Director of Research: (principal RF circuit-system designer and manager of a small team that introduced a family of highly successful ultrasound imaging products) - ATL (purchased by Phillips Medical of Bothell, WA). I was personally responsible for all performance aspects of these early ultrasound scanner systems. ATL products were so successful that the company grew to be a leader in their market. Ultrasound scanner systems that I designed have been (temporarily) on display at the Smithsonian.

1980-1983 Consultant – Designed a family of high power (1 KW) true sine wave switchmode power inverters (Dynamote Corporation); produced a general study on subterranean Directional Drilling technology (Golder Assoc); consulted on Transcutaneuos Electroneural Stimulation (TENS) Systems; Designed a calibrated infrared camera system for monitoring and control of a large pulp and paper mill "liquor" furnace (Weyerhaeuser Research); Designed an acousto-optic modulator, a wideband water submersible photo detector and a Doppler shifting Michelson interferometer for absolute velocity calibration of vibrating membranes.

1983-1994 CEO/Founder: NTR Systems, Inc.: Designed, manufactured and marketed many physical acoustic research sensors, instrumentation and software products. These include broadband hydrophones, calibration transducers and computer controlled transducer positioning and data acquisition devices. NTR products were sold worldwide. I was Principal Investigator for several industrial and NIH R&D contracts. I was a member of the Technical Advisory Group for US-IEEE standards on medical ultrasound safety. I received three instrumentation utility patents. I presented three conference papers. On the average, I had five full time employees.

1994 - 2000 Consultant - Electro-physical sensors and ultrasound instruments … principal projects being an ultrasound system for quantitative, non-invasive cardiac output measurement (SpaceLabs). On average, three people reported to me. I FEA modeled ultrasound beams, designed transducers and front end electronics for a fetal heart monitor system. This one I did solo. Both systems worked well.

2000-2007 Principal Research Engineer: Neah Power Systems, Inc. (Meso-Porous Silicon based Direct Methanol Fuel Cells - 5 to 50 watts). Designed and tested various switchmode DC-DC converter devices. Designed a complex electrochemical silicon etching cell – this system included a high power large area infrared illuminator with uniform irradiance; designed and FEA analyzed a non-contacting RF eddy current conductivity instrument for measuring trace doping levels in MEMS porous silicon wafers; I analyzed many thermal-mechanical, micro-fluidic and electrochemical fuel cell concepts using full field multi-physics FEA and other methods. Models I created gave information that could not have been obtained any other way. I designed micro-fluidic piezo pumps and related diaphragms and valves for use in highly corrosive chemical environments. I set up and occasionally ran a full-blown chemical compatibility test program to identify adhesives, elastomers and structural materials that can withstand relatively high concentrations of combinations of nitric, sulfuric, methanol and hydrogen peroxide solutions. I did elaborate statistical analysis and system identification for the electrical noise present on fuel cell electrodes. Related to this was signal extraction and processing of the output from an optical bubble detector I designed. I designed a diode laser welding system for fusion bonding laminated plastic micro-fluidic subsystems. I helped develop safety regulations for micro fuel cells through working committees of UL and the US Fuel Cell Council.

Please see the following page for additional information:

Addendum:

In my grad school days I designed and fabricated small telemetry "capsules" for long-term implantation in rabbits. These small devices sensed and transmitted fallopian tube motion patterns to a receiver system external to the animal. The goal was to learn how various hormonal drug regimes affected oviduct, and thus ovum, motility and fecundity. Though my resume doesn't dwell on it, I have quite a bit of electro-optical, electromagnetic RF eddy current and microwave NDE experience.

At one time or the other, I developed a temperature calibrated "full field" infrared camera system for control of a huge pulp and paper mill "liquor" furnace (Weyerhaeuser Research); a home made acousto-optic modulator for use as a Doppler shifting Bragg diffraction "mirror" in a Michelson interferometer; a high power, uniform irradiance infrared illuminator for hydrofluoric acid etching of porous silicon wafers (Neah Power Systems); a very wideband, submersible in water, photo detector (NTR Systems); a class IV laser diode actuated welding system for fusion bonding thin plastic laminates. For fun and personal education, I also set up a simple, high intensity, self-focused laser beam numerical model using the raw textbook eikonal equations within a general purpose PDE solver application program. The model gave results which, I believe, display the correct physics.

I also was principal investigator for an NIH grant to develop a wideband laser-ultrasound calibration system that simultaneously measured the acoustic field intensity of a sound beam and the Doppler shift of a laser beam reflected from the back surface of a piezoelectric plastic membrane acoustic field amplitude sensor.

I have my own modest home lab with a computer controlled mechanical scanning tank, hydrophones, pulsers, vector network analyzers and other useful ultrasound, optical, microwave and sensitive electro-physical test instruments.

For many years I had a small business making acoustic power and intensity (AP&I) measurements for medical ultrasound manufacturers. My company, NTR Systems, Inc. also designed, made and sold a wide range of hydrophones, scanning tanks and related instrumentation for characterizing ultrasonic transducers and systems.

I also have a fair amount of experience with taming difficult control system problems. Specifically, I developed and patented an ultrasonic power sensing radiation force balance with microgram sensitivity. A minute acoustic radiation pressure was sensed by a 6 inch diameter disk shaped absorbing target that was pulled downward against a small buoyant force, in a water bath, by an electromagnet. The absorbing target position was sensed and controlled, to within less than a micron RMS, with a linear differential transformer that was co-located inside the electromagnet. I designed all parts of the system, including the control system and electro-magnetics

I have also done RF eddy current and microwave NDT device and system development. In particular, I have designed and numerically modeled a simple but effective cup core sensor for non-contact measuring of the conductivity of porous silicon wafers after MEMS modification. The model was an FEA solution of Maxwell's time harmonic diffusion equations that I set up in a general purpose PDE solver application program. This measurement system has been in routine QA and R&D use for about three years now. I have also set up a microwave lab that allows me to non-invasively interrogate materials up to 18 GHz.

Recently, I have designed small piezo and magnetically actuated diaphragm pumps, valves and related electronic drivers. These devices were required to handle corrosive chemicals and operate over a fairly wide flow range. Associated with this work I modeled single and two phase fluid flow in small channels and pores in meso-porous silicon wafers.

In the last seven years, I have developed substantial Finite Element Analysis (FEA) modeling skills. I have done well over a hundred diverse FEA models, many of which are full blown multi-physics numerical experiments. Many of these models were for micro-fluidic and electro-chemical MEMS electrodes and related devices. I understand and can model the combined fluid dynamic and electrochemical nature of a metal-electrolyte electrodic interface. I have done other models that examine mechanical stress, ultrasound fields, heat flow, electromagnetic field diffusion and radiation in open, wave-guiding and conductive media situations.

Generally speaking, I feel qualified to successfully design, measure, analyze and manage the design, of complex and exotic devices and systems spanning a rather wide range of microfluidic, electrophysical, ultrasonic, NDE, electrochemical, microwave, optical and electromechanical disciplines.