

Edward W. Leaver
Senior Software Engineer, Scientific Programmer/Analyst, C/C++ Linux

www.edleaver.com

- Strong background in physics, chemistry, mathematics, and computation.
- Graphical User Interface design and development: GTKmm and Qt tool kits, C++ and QML
- Ten+ years experience object-oriented C++ Linux coding and project development, including design patterns in a multi-threaded distributed disk seismic data archive and retrieval program, and multi-threaded image processing. Red Hat, Ubuntu, SuSE Linux.
- Ongoing image co-registration and hyperspectral analysis endeavors.
- Geoelectromagnetic modeling, and acoustic wave propagation using anisotropic 3D ray-tracing.
- Object oriented design and analysis, design patterns and multi-threaded development.
- Computer cryptography and secure network programming (RPC, TCP, UDP, OpenSSL).
- Numerical analysis, linear, non-linear, and genetic algorithm optimization.
- Intel Threading Building Blocks, Cuda, Boost, STL, ClearCase, svn, git, gdb, valgrind, Eclipse.
- Strong C/C++ and Fortran. Python, Perl, shell, XML, HTML5. Starting PostGIS SQL.

Project Experience

(Employment history see page 4.)

Remote Sensing / Image Processing

Icarus Image is an ongoing personal project to obtain optimized unsupervised end member identification of remote-sensing hyperspectral images. Written in C++ with a Qt GUI interface, it involves GDAL input/output of multi-dimensional raster images, georeferencing, and datum conversions. Part of this is done as I/O plugins for Ball Aerospace Opticks GIS program. Computationally intensive gpu algorithms are implemented using Cuda.

In contrast to 3-band RGB images, hyperspectral images are aerial photographs whose camera records several hundred narrow bands between the near ultraviolet and short-wave infrared. Such spectral resolution allows for geochemical and biochemical image characterization on a pixel-by-pixel basis.

Icarus Image is developed through Icarus Resources (my personal LLC) 2008 present. Interface screen shots and a brief description are available online at <http://www.edleaver.com/Misc/Projects/Occm/Articles/IcarusImage/index.php>

GIS Vector Mapping

Recently wrote Python filters and geometry modifiers for a geology customers map application. GDAL/OGR processing and generation of MapInfo and Esri shapefiles.

Single Board Embedded

Currently designing an embedded security device, Odroid C2 Arm A53, C++ Ubuntu 16.04 Linux. Earlier acquired an Nvidia Jetson Tegra K1 development board for embedded Qt interface and image processing development. This runs a real-time Ubuntu 14.04 kernel, but security app has taken priority. Both projects are with Icarus Resources, my personal LLC.

Embedded C++ and Qt/QML

Most recent position (2015) was a short-term contract through Oxford Global Resources, debugging user interface issues and some development for an embedded infotainment system based on Qt/QML 5.2. Target platform was Ubuntu 14.04 on an ARM platform, but for this project development was on Ubuntu x86 desktop with Qt's qmlviewer tool. The C++ back end was done by others.

Low-Level Programming / Medical Embedded

Automated unit and thread verification tests, software documentation, and analysis of low-level message-passing integrity (mutex, semaphore, condition variables) for GE Healthcare OEC. Using C++ on SuSE Enterprise Linux running a real-time kernel for an embedded medical imaging device, this medium-sized project used ClearCase CMS, DOORS document management, and Parasoft/Eclipse IDE. Short-term contract through Adecco Engineering and Technical Services, 2011 - 2012.

Geoelectromagnetic Consultation

Towards the end of 2009 I did some simple resistive layered-earth modeling (C++) to support a local geological exploration company's evaluation of a third-party electromagnetic geophysical exploration tool and analysis scheme. My modest analysis, described in some detail at <http://www.edleaver.com/Misc/Projects/FreeModesLayeredResistiveMedia/Article/ElectromagneticFreeM> helped save my client a fair chunk of time, change, and frustration.

Systems Applications Programming / Data Storage

Icarus Archive is an enterprise data archive and retrieval program for Landmark Graphics' Pro-MAX seismic data sets, intended to facilitate convenient and selective data storage and sharing among client processing sites. The project entailed extensive Linux C++ system programming, utilized the envelope-letter Design Pattern in its file cache, and includes SCSI tape control and a GTKmm GUI. STL map, list, and vector containers are used as needed. (Red Hat Linux, programming in C++) Icarus Archive was undertaken in partnership with a local seismic data processing house under auspices of Icarus Resources, my personal LLC, from 2003 – 2008. Due to ease and flexibility of data archive and retrieval, it gave the partner considerable edge in a highly competitive industry. Icarus Archive and its Quick Start Guide are at <http://www.edleaver.com/Misc/Products/IcarusArchive/index.php>

Systems Applications Programming / Secure Network Communication

The Icarus Archive project entailed development of a secure networked license management daemon and client support library, which feature encrypted and keyed Berkeley socket network communications utilizing TCP and UDP transport protocols and OpenSSL. The license manager is quite flexible, can exchange arbitrary encrypted buffers, and may host any client application that links its library (security caveats apply). Red Hat Linux C and C++, Icarus Resources 2008.

EDA Circuit Simulation and Device Modeling

Initially introduced to Berkeley SPICE (Simulation Program with Integrated Circuit Emphasis) in a project estimating short-burst microwave effects on a large commercial air frame, I eventually ended up employed at IBM Micro Electronics EDA Division in East Fishkill, NY (1995 - 2002) as part of IBM's PowerSPICE development team. There we had five or six developers, plus a product support engineer and documentation writer. All development was in C++ on IBM's AIX Power platform. My own contributions included:

- Writing an early yacc-based SPICE parser and C-language diode model. This was the first time the SPICE netlist language had been implemented in an IBM circuit simulator, and the new feature was greatly appreciated by our internal customers. PowerSPICE is a fairly large program; I also spent quite a bit of time just on support, and provided documentation drafts.
- Implementing both an implicit trapezoidal and an A-Contractive multivariate differential equation integrator for the PowerSPICE simulator. Trapezoidal integration is used in our external competitor's HSPICE product, where it is quite fast. PowerSPICE and its ASTAP predecessors originally used the more conservative second-order Gear BDF integration technique. A-Contractive is a hybrid algorithm developed at IBM's Watson Research Center, and incorporates the best properties of trapezoidal and backwards difference integration. (AIX, programming in C++)
- Helped IBM's Compact Modeling Group (Burlington, Vt.) adapt Genetic Algorithm to optimize BSIMPD mosfet device model parameters, then later to optimize values for piece-wise planar spline knots for IBM's high-speed ACES simulator. The BSIM family of software models can have over 300 parameters that may be tuned to a particular fabrication process. In principle these are all based on device physics, but in practice we found it easiest to design and build a hardware fabrication process, then tune software device model parameters to best describe the behavior of simple on-wafer test circuits. This allowed IBM to produce more accurate software device models over a wider range of wafer fabrication parameters in a shorter time, thereby increasing the productivity of our in-house circuit designers and decreasing time-to-market of IBM's state-of-the-art and highly-competitive ASICs. A highly rewarding position. (C++, AIX)

EDA Other

Briefly worked at Intel's Texas Design Center in 2012-2013, porting automated layout tools from Perl to C++ on HP-UX Unix operating system. This was in support of the Tejas high-speed processor design. Tejas was the last of Intel's Netburst architectures. It was eventually canceled.

Employment History / Professional Experience

- Oxford Global Resources, Madison WI. April - June 2015. Software Engineer (contract).
 - Qt consulting for embedded aerospace application. Worked with Qt's QML/JavaScript front end on the customer-facing graphical interface. Client was Zodiac Aerospace..
 - The modest C++ coding here was for simple thread condition/wait unit tests.
 - Used JIRA, Coverity, SVN, and Qt 5.2.1 on Ubuntu 14.04
 - ARMv7 target, QML UI development was via Qt qmlviewer tool on x86 Ubuntu desktop.
- Icarus Resources, Denver CO. 2003 - Present. Icarus is my personal LLC; I am President, project lead, and principal developer on several interesting projects:
 - Icarus Archive, 2003 - 2008. Interactive seismic data archive and retrieval program. Responsibilities included collecting project requirements from senior geophysicist, design and implementation of data structures needed to support user selection of seismic data subsets, design and coding of graphical user interface (C++ using GTKmm toolkit), writing user documentation, and designing test protocols and archive verification tools.
 - Secure networked license manager and client support library, written in 2008 to support Icarus Archive. It was my responsibility to design the API's and communications protocol between the application clients (in this case the Archive programs running on user workstations), and the license server daemon running on a remote network node. Researched secure network communication, and techniques to implement tamper-resistant non-modifiable code. I also did all the coding (C and C++).
 - Electromagnetic Free Modes of Layered Resistive Media study, 2009 - 2010. I was asked by the client, Thomasson Partner Associates, to evaluate a third-party reservoir exploration tool which claimed the ability to distinguish subtle conductivity variations at depths up to several kilometers. My responsibility (and challenge) was to convince TPA's non-physicist geologists that – simple skin-depth considerations aside – the electromagnetic free-modes the vendor's tool purportedly could detect have no real support on this planet, and there are fundamental physicals reasons the "data" the vendor was showing them so strongly resembled band-limited white noise. I defined the layered-earth model and coded its complex reflection/transmission coefficients in C++.
 - Icarus Image, 2008 - present. Hyperspectral image processing. This is a personal project, the client is myself. It is my responsibility to undertake literature search and combine existing enhancement and end-member extraction algorithms in new ways, and thereby enable image refinements not offered by other commercial tools. I do all the back-end physics coding, as well as the Qt interface design and implementation. (Red Hat / Fedora)

- Adecco Engineering and Technical Services, Denver, CO. October 2011 - March 2012 Software Engineering Associate (contract).
 - C++ programming on SuSE Enterprise Linux running a real-time kernel for an embedded medical imaging application. Client was GE Healthcare OEC.
 - Developed, refined, and documented automated unit and C++ thread verification tests.
 - Wrote software documentation, and analyzed low-level message-passing integrity mutex, condition variables, semaphores and friends.
 - Project tools included Rational ClearCase CMS, Parasoft Eclipse IDE, and DOORS.
- Intel Texas Development Center, Austin TX. 2002 - 2003. Advisory Software Engineer. Ported circuit layout optimization tools from Perl to C++ on HPUX.
- IBM Micro-Electronics EDA Division, East Fishkill NY. 1995 - 2002. Advisory Software Engineer. C++ circuit simulator development and device model parameter optimization on AIX. Responsibilities included defining syntax requirements for SPICE language parser, defining interface for new ODE integration algorithms, defining a common device-model build environment for ASTAP and PowerSPICE simulators, and defining API extensions for more efficient device model evaluation within PowerSPICE. Defined requirements for new diode model incorporating correct reverse-breakdown behavior and C 1 continuity. I also ended up coding most of this. Plus general PowerSPICE documentation and maintenance. Coded much of the Compact Modeling Group's Genetic Algorithm BSIM3 device parameter optimization program, then defined Genetic Algorithm interface to IBM's high-speed ACES simulator, and provided C++ stub code.
- Advanced Computer Systems and Technology, Jet Propulsion Laboratory, Pasadena, CA. Member Technical Staff 1988 - 1990. Hypercube applications in particle and atmospheric physics, and SDI simulations. Applications and systems programming exploiting parallel processing on the Caltech-JPL hypercubes.
 - C/C++ development of battle management components for SDI simulations on the Caltech-JPL Mark III Hypercube.
 - Helped parallelize numerical plasma simulation (Particle-in-Cell algorithm)
 - Wrote API and library for client-server atmospheric infrared emission spectral synthesis code.
 - First port of SLATEC Fortran scientific library to Unix environment.
 - C, C++, and Fortran on Hypercube and Unix (SunOS) operating systems.
 - Advanced the theory of ellipsoidal wave equations, with application to gravitational wave spectra of charged black holes.

- Electromagnetic Applications, BDM Corporation, Albuquerque, NM. 1986 - 1988.
Member Technical Staff
 - Spice-based EMP analysis of commercial airframe
 - Ground-plane reflectance modeling of an EMP test facility
 - Contributed radiative boundary conditions to a finite-difference plasma simulation.
 - Assisted radar cross-section study of UAV.

(BDM was acquired by TRW in 1997; thence by Northrop-Grumman in 2002.)

Interests

Remote sensing, geophysics, climate and energy and related economic issues. Electronics is a hobby: multimeter, oscilloscope, signal generators, distortion analyzer. Comfortable in a laboratory environment.

Education

BA. Chemistry, University of Colorado Boulder. Coursework included Geology, Biochemistry, Electricity and Magnetism, Economics, and a minor in Mathematics.

PhD. Physics, University of Utah Salt Lake City. Dissertation: "Solutions to a Generalized Spheroidal Wave Equation and the Quasinormal Modes of Kerr Black Holes."

Course work included Electronics, Electrical Methods of Exploration, Seismology, Signal Processing, and Computational Chemistry.

Publications:

- E.W. Leaver, “An analytic representation for the quasinormal modes of Kerr black holes.” Proc. R. Soc. Lond. A. **402**, 285–298 (1985).
- E.W. Leaver, “Solutions to a generalized spheroidal wave equation: Teukolsky’s equations in general relativity, and the two-center problem in molecular quantum mechanics.” J. Math. Phys. **27**, 1238–1265, (1986).
- E.W. Leaver, “Spectral decomposition of the perturbation response of the Schwarzschild geometry.” Phys. Rev. D. **34**, 384–408 (1986).
- E.W. Leaver, “Quasinormal modes of Reissner-Nordström black holes.” Phys. Rev. D. **41**, 2986 (1990).
- E.W. Leaver, “Remarks on the continued fraction method for computing black hole quasinormal frequencies and modes.” Phys. Rev. D. **45**, 4713 (1992).
- E.W. Leaver, Comment on “High-overtone normal modes of Schwarzschild black holes” Class. Quant. Grav. **9**, 1643-1648 (1992).

Conference Participation:

- E.W. Leaver, *A new black hole radiation effect*, The 13th Texas Symposium on Relativistic Astrophysics (General Relativity poster session), Chicago, December 1986.
- E.W. Leaver, *Analytic and numeric properties of new representations for the radial generalized spheroidal wavefunctions*, SIAM 35th Anniversary Meeting, Denver, October 1987.
- C.B. Wallace, D.W. Harmony, R.C. Smith, J.C. McClune, R.E. Cabeen, and E.W. Leaver, *Non-linear FCT simulations of MILO oscillators*, APS Division of Plasma Physics Thirtieth Anniversary Meeting (poster session), Hollywood, FL, November 1988.
- P.C. Liewer, E.W. Leaver, V.K. Decyk, and J.M. Dawson. *Concurrent PIC codes and dynamic load balancing on the JPL-Caltech Mark III hypercube*, 13th Conference on the Numerical Simulation of Plasmas (invited talk), Santa Fe, NM, September 1989.
- E.W. Leaver, P.C. Liewer, V.K. Decyk, and J.M. Dawson. *Dynamic Load Balancing of a Concurrent PIC Code*, APS Division of Plasma Physics Thirty-First Annual Meeting (poster session), Anaheim, CA, November 1989.
- E.W. Leaver. *Algebraic Specialty and Black Hole Normal Modes* Sixth Gregynog Relativity Workshop, Wales, UK, August 1993.

I have refereed for *The Physical Review*