Software

Open-Source Software for Modeling of Nanoelectronic Devices

The Nanoelectronic Modeling 3-D (NEMO 3-D) computer program has been upgraded to open-source status through elimination of license-restricted components. The present version functions equivalently to the version reported in "Software for Numerical Modeling of Nanoelectronic Devices" (NPO-30520), *NASA Tech Briefs*, Vol. 27, No. 11 (November 2003), page 37. To recapitulate: NEMO 3-D performs numerical modeling of the electronic transport and structural properties of a semiconductor device that has overall dimensions of the order of tens of nanometers. The underlying mathematical model represents the quantum-mechanical behavior of the device resolved to the atomistic level of granularity. NEMO 3-D solves the applicable quantum matrix equation on a Beowulf-class cluster computer by use of a parallel-processing matrix·vector multiplication algorithm coupled to a Lanczos and/or Rayleigh-Ritz algorithm that solves for eigenvalues. A prior upgrade of NEMO 3-D incorporated a capability for a strain treatment, parameterized for bulk material properties of GaAs and InAs, for two tight-binding submodels. NEMO 3-D has been demonstrated in atomistic analyses of effects of disorder in alloys and, in particular, in bulk $In_xGa_{1-x}As$ and in $In_{0.6}Ga_{0.4}As$ quantum dots.

This program was written by Fabiano Oyafuso, Hook Hua, Edwin Tisdale, and Gerhard Klimeck of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

This software is available for commercial licensing. Please contact Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-30843.

Software for Generating Strip Maps From SAR Data

Jurassicprok is a computer program that generates strip-map digital elevation models and other data products from raw data acquired by an airborne synthetic-aperture radar (SAR) system. This software can process data from a variety of airborne SAR systems but is designed especially for the GeoSAR system, which is a dual-frequency (P- and X-band), single-pass interferometric SAR system for measuring elevation both at the bare ground surface and top of the vegetation canopy. Jurassicprok is a modified version of software developed previously for airborne-interferometric-SAR applications. The modifications were made to accommodate P-band interferometric processing, remove approximations that are not generally valid, and reduce processor-induced mapping errors to the centimeter level. Major additions and other improvements over the prior software include the following:

- A new, highly efficient multi-stage-modified wave-domain processing algorithm for accurately motion compensating ultra-wideband data;
- Adaptive regridding algorithms based on estimated noise and actual measured topography to reduce noise while maintaining spatial resolution;
- Exact expressions for height determination from interferogram data;
- Fully calibrated volumetric correlation data based on rigorous removal of geometric and signal-to-noise decorrelation terms;
- Strip range-Doppler image output in user-specified Doppler coordinates;
- An improved phase-unwrapping and absolute-phase-determination algorithm;
- A more flexible user interface with many additional processing options;
- Increased interferogram filtering options; and
- Ability to use disk space instead of random-access memory for some processing steps.

This program was written by Scott Hensley, Thierry Michel, Soren Madsen, Elaine Chapin, and Ernesto Rodriguez of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

This software is available for commercial licensing. Please contact Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-40032.

Calibration Software for Use With Jurassicprok

The Jurassicprok Interferometric Calibration Software (also called "Calibration Processor" or simply "CP") estimates the calibration parameters of an airborne synthetic-aperture-radar (SAR) system, the raw measurement data of which are processed by the Jurassicprok software described in the preceding article. Calibration parameters estimated by CP include time delays, baseline offsets, phase screens, and radiometric offsets. CP examines raw radar-pulse data, single-look complex image data, and digital elevation map data. For each type of data, CP compares the actual values with values expected on the basis of ground-truth data. CP then converts the differences between the actual and expected values into updates for the calibration parameters in an interferometric calibration file (ICF) and a radiometric calibration file (RCF) for the particular SAR system. The updated ICF and RCF are used as inputs to both Jurassicprok and to the companion Motion Measurement Processor software (described in the following article) for use in generating calibrated digital elevation maps.

This program was written by Elaine Chapin, Scott Hensley, and Paul Siqueira of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

This software is available for commercial licensing. Please contact Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-40015.

Software for Probabilistic Risk Reduction

A computer program implements a methodology, denoted probabilistic risk reduction, that is intended to aid in planning the development of complex software and/or hardware systems. This methodology integrates two complementary prior methodologies: (1) that of probabilistic risk assessment and (2) a risk-based planning methodology, implemented in a prior computer program known as Defect Detection and Prevention (DDP), in which multiple requirements and the beneficial effects of risk-mitigation actions are taken into account. The present methodology and the software are able to accommodate both process knowledge (notably of the efficacy of development practices) and product knowledge (notably of the logical structure of a system, the development of which