Computer Software Reviews

LabVIEW. Version 1.1. National Instruments: 12109 Technology Boulevard, Austin TX 78727-6204. List Price $1995. GPIB-MAC Instrumention Bus, $595–$795 (depending on memory, 2K, 8K, 32K).

LabVIEW is an Apple Macintosh software package for use in laboratory computing. The name of the software is an acronym for *Lab*oratory *V*irtual *I*nstrument *E*ngineering *W*orkbench and is designed as a complete set of applications for instrument and process control, data acquisition, and scientific computing including simulation, data analysis, signal processing, data base operations, and graphics capabilities. In fact, the software consists of a higher level computer programing language, called G, and numerous subroutines all of which are utilized and accessed by an "intuitive diagraming technique". Programing with LabVIEW amounts to wiring ready made or user made icons together in a block diagram. A LabVIEW program is called a virtual instrument (VI) and consists of two parts: (1) a front panel with controls and indicators which take the input and output data and (2) a wiring diagram which is a block diagram of wired icons (see Figure 1). A virtual instrument can be hierarchical since an icon of one VI can include other VI's as components. The net result is a modular programing system for on-line laboratory applications and scientific computing which should appeal to engineers and scientists who are partisan to block diagraming. This aspect of the software package is truly novel and owes it evolution to the Macintosh graphical interface. Furthermore, for the end-user who is not a developer, the front panel is all that is necessary to run the VI program and the graphics allows this panel to look like an instrument panel with switches, dials, meters, charts, etc. (Figure 1).

The LabVIEW software system can be run on an extended Mac with at least one megabyte of RAM or a Mac Plus either of which must have a second 800K external floppy drive. It is also possible to run LabView on a Mac SE or Mac II. A system with only two floppy drives for slow memory is a rather minimal hardware configuration which will require a fair amount of diskette swapping. I tested the system on a Mac Plus in the above configuration and on an extended Mac with 2M RAM and a 20M hard-disk drive and found the latter a great deal more convenient. The need for more slow storage memory is readily appreciated when one considers that Version 1.1 of the software distribution comes on five 800K diskettes which include a system disk, program disk, utilities disk, instrumentation disk, and signal processing disk. Apple's System Version 4.1 and Finder Version 5.5 are recommended, and this configuration does not leave much room on the system disk so that the main LabVIEW files, LabVIEW and LabVIEWRsrcs, must be placed on a second diskette which then allows just enough space for about one user application between the two diskettes. A nicely documented Help file is available, but without large capacity storage, it must be accessed by disk swapping. LabVIEW is not file protected, makes use of the hierarchical file system (HFS), and can be used with the Switcher. For the Mac II or in other configurations which contain an arithmetic 68881 coprocessor, the software is supposed to try to use it.

The written documentation for Labview comes in two three-ring notebooks and includes a step-by-step introduction for using LabVIEW which is very well done. This introductory section has its space limitations and so most details for use of the software are given in the reference and function sections. While the introduction (Using LabVIEW) is easy to follow, the reference and function sections are less pedagogical in approach and more typical of software manuals written for conciseness. It is easy to follow the introduction and to "wire" your first LabVIEW programs, i.e., virtual instruments. These programs are typical of LabVIEW applications. Examples are a VI which produces a plot of a Lissajous figure or one that finds the mean and standard deviation of an array of random numbers. This latter program or virtual instrument is given an icon using an icon editor in the Format menu and subsequently used as a sub-virtual instrument in a VI which plots a histogram of the means of several runs of the random number generator. The program uses a data base icon which can log the data when the VI is running. Data are stored with the VI and can then be accessed with the File menu item, Retrieve Data, in which the run number, time, and date are stored for each datum. This complete graphics application is quickly assembled from a group of four icons and a For Loop structure. In general, learning to program with LabVIEW is conceptually straight forward; however, there are a large number of details to learn before one can become proficient in its use.

The scope of what can be done with LabVIEW software is, indeed, very large. LabVIEW has over 175 built in functions some as simple as the sine function or square root function and others as complicated as a white noise generator, crosscorrelation, or inverse matrix function. Each function is represented by an icon which can have one or more inputs and outputs. For example, the linear fit function has X data and Y data as inputs (1D arrays) and best linear curve, Y′, slope and intercept coefficients, mean squared error, and an error code as outputs. Built in functions include arithmetic functions, Boolean logic functions, a formula calculator function, a random number function, comparison and decision functions, timing (clock) functions, transcendental functions, intput–output (file manipulation, serial port, GPIB-MAC, and MAC-BUS) functions, and array, string, and graphics functions. Also included as functions are signal generators (sine, impulse, pulse, ramp, triangle, sinc, white and Gaussian noise) which generate 1D array waveforms and signal processing algorithms such as complex and real FFT, convolution, power spectrum, cross- and auto-correlation, and waveform manipulations (integration, differentiation, time reversal, clipping, shift and various types of windowing). Statistics, vector algebra, matrix algebra, and some miscellaneous functions, such as N factorial and polar-rectangular conversions, completes the list of LabVIEW "subroutines". These functions coupled with four control structures: sequence, case select, for-loop, and while-loop, allow for program generation. In effect LabVIEW provides a powerful subroutine library for laboratory and number crunching computing.

If one is only interested in operating a particular real instrument which has a GPIB or serial interface with a LabVIEW program(VI), the software comes with about ten preprogramed VI's, such as an HP 3314A function generator or a tektronix AA5001 distortion analyzer. Actually National Instruments has at least 80 VI's available for real instruments,

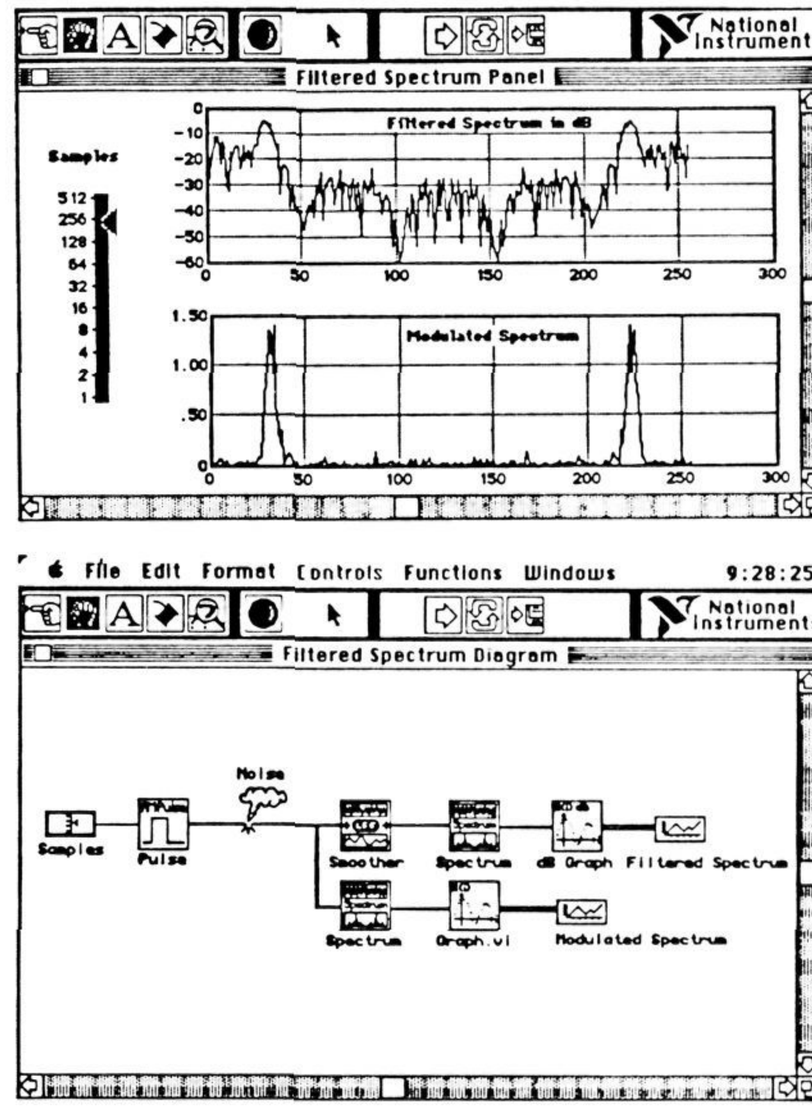

Figure 1. Example of a LabVIEW panel and diagram. The virtual instrument is called Filtered Spectrum, and the panel has one input, the number of samples, and two outputs, a Filtered Spectrum and a Modulated Spectrum. In this application noise is added to a digitized amplitude modulated pulse and the power spectrum of a filtered signal is taken and compared with the modulated spectrum. Some of the icons like Spectrum and Graph.vi are built in functions and others like AM-Pulse and Smoother are virtual instruments that must be developed.

and they are also willing to program, as a service, any instrument that is capable of communicating with a digital computer via a GPIB (IEEE-488) or serial (RS-232) interface. In order to use an instrument which has a GPIB interface, a GPIB controller, such as National Instruments GPIB-Mac controller, for example, must be available which can be accessed via a Mac's serial (modem) port or via its SCSI port with MacBus. In the future LabVIEW will have drivers to operate input–output boards for the Mac II. With a Virtual Instrument for a given piece of laboratory equipment interfaced to a Mac via a GPIB-Mac controller or an instrument board (Mac II), the user has at his disposal the data manipulation capabilities of the LabVIEW software which include plotting, statistical analysis, wave form analysis, number crunching, and file and data base manipulation.

As a test of the laboratory computing capabilities of LabVIEW, a 2K National Instrument GPIB-Mac controller was used with a MacPlus to control a Keithley 4853 picoammeter with a GPIB interface. With use of built in LabVIEW GPIB functions, all device dependent commands could be accessed remotely one at a time and data read in to the computer from the instrument in single steps. However, to write a LabVIEW VI which allows complete set up of a particular set of instrument functions and ranges proved difficult. This was because a single string consisting of several device dependant commands could not be read into the Keithley instrument, although the manual states that this is possible. This situation may be a problem with the Keithley 4853 GPIB interface and not with LabVIEW; however, it should be pointed out that the GPIB-Mac controller can also be programed with BASIC where it is not necessary to use such a string command. Thus the question arises as to the advantages that LabVIEW gives over input–output programing with BASIC or some other language that can communicate with a controller. The main advantage of LabVIEW is not in the ease of input–output programing but rather in the user-friendliness that the front panel concept gives to labVIEW applications and the data logging, data manipulation, and graphics capabilities that it possesses. This software system would seem to be of most interest to chemists who either want to use a Macintosh system as a general laboratory computer or who have instrumentation with a GPIB interface and applications which involve extensive waveform analysis.

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Book Reviews*

Growth of Crystals. Volume 14. Edited by E. I. Givaryizov (Academy of Science, USSR), translated by J. E. S. Bradley (University of London). Consultants Bureau: New York and London. 1987 (from Russian text published in 1983). viii + 199 pp. $65.00. ISBN 0-306-18114-2

This volume is similar to preceding volumes in this series in consisting of a compilation of papers in its specialized area. Despite its appearance as a hard-cover book, it is not a monograph; it has no unified or systematic organization in terms of content and no subject or author indexes. Rather, it is the equivalent of an issue of a regional journal. It contains 18 papers, the authors of all of which are from state institutes in the USSR.

The contributions are grouped into three categories. Part I contains papers dealing with the production or properties of thin films, with emphasis on polycrystalline and amorphous materials, and includes some new material in this industrially important field. Here, Givaryizov presents a brief literature survey of research approaches to producing oriented crystal films on amorphous substrates and shows some results he has obtained in producing oriented overgrowth of GaAs on an SiO_2 or Si substrate, and CdS on glass. Aleksandrov offers a theoretical treatment of the mechanism of accelerated crystallization; e.g., of amorphous films of Sb, Si, or Ge on glass induced by local pulsed heating, shock, or cleavage. Lyutovick details his experimental results in producing film crystallization through bombardment with ion beams. Solid-state epitaxy is a technique that seeks to form crystalline thin films at lower temperatures than traditional epitaxial deposition methods by interposing a thin metal film between the deposited material and the substrate; this approach is reviewed by Palatnik and Fedorenko. Sokol and Kosevich describe qualitatively the factors affecting crystal growth in amorphous films of Sb, Se, Te, Sb_2S_3, In_2Te_3, and Nb_2O_5. Stenin discusses the spontaneous formation of defect and dislocation structures during the deposition of heteroepitaxial films; e.g., Ge on SiO_2 and Si on Si_3N_4. Mil'vidskii and Dolginov describe some aspects of the production and properties of a few uncommon epitaxial heterostructures composed of quaternary solid solutions; e.g., InGaAsP on InP.

The papers in Part II deal with crystal growth in multicomponent systems. Temkin proposes a theoretical model for nucleation kinetics based upon the composition of the nuclei and the diffusion rates of the constituent species. Birman offers a thermodynamic treatment of crystal composition and growth in systems having complex phase diagrams, such as in the case of cement hydration. Barsukova and Kuznetsov provide data on the stability and growth by hydrothermal synthesis in fluoride media of Mg, Ca, Sr, Ba, Fe(II), Co(II), Ni(II), Pb, Mn(II), and Bi titanates. Punin employs microscopy to investigate the morphology and kinetics of defects produced in crystals due to plastic relaxation of growth stresses. Davtyan et al. describe the production of optical quality potassium pentaborate tetrahydrate crystals from neutral aqueous solutions by cooling from 70 °C to room temperature.

Of the six papers in Part III, four are by Tatarchenko and co-workers. These latter are mainly theoretical and deal with the problem of controlling the shape and crosssection dimensions of crystals that are grown from melts in which the side surface is produced free of contact with the walls of the container. The specific techniques discussed are those due to Czochralski, Stepanov, and Verneuil, as well as the floating zone method. Smirnov et al. offer a computer simulation of the velocity, temperature, and dopant concentration distributions for Ge grown by the Czochralski method. Antonov and Bakholdin give a qualitative interpretation of the profile of crystals grown from the melt as arising from the anisotropy of the crystal itself, plus the effect that factor has on the temperature pattern near the crystallization front.

The translation from the Russian is well done and is technically competent. The text is quite free of editorial and typographic faults. The Consultants Bureau continues to provide a valuable service to those of us who do not have entry into the original Russian literature.

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Annulenes, Benzo-, Hetero-, Homo-Derivatives, and their Valence Isomers. Volumes 1, 2, and 3. By Alexandru T. Balaban and Mircea Banciu (The Polytechnic, Burcharest) and Vasile Ciorba (Foreign Trade Ministry, Bucharest). CRC Press Inc.: Boca Raton. 1987. Volume 1: xiv + 251 pp. Volume 2: xiv + 231 pp. Volume 3: xii + 206 pp. $395.00. Volume 1: ISBN 0-8493-6880-4. Volume 2: ISBN 0-8493-6881-2. Volume 3: ISBN 0-8493-6881-0

This three-volume series is a very timely and welcome addition to the organic literature. Most of the chemistry reviewed in this book has never been collectively addressed and certainly there exists no other monograph that covers the broad field of not only annulene chemistry but also the related areas of benzo-, hetero-, and homo-annulenes as well as their valence isomers. This book goes considerably beyond another recent contribution in the field, written by Douglas Lloyd and published in 1984.

The three volumes are divided into ten chapters, Volume 1 begins with three introductory chapters written by Balaban, which encompass 65 pages. These chapters introduce the book and then address the subjects of aromaticity and graph theory. In his introduction Balaban claims that the book will follow a "Sherlock Holmes" type approach in that graph theory will be used to delineate all possible graphs depicting $(CH)_n$ isomers. This list will then be pruned of irrelevant graphs and finally compared to known compounds. Luckily for the reader, this approach is not seriously implemented after Chapter 3. Other stated objectives of the book are to provide a short-cut to the vast literature of the field and to provide inspiration for synthetic chemists. In these respects the authors succeed very well.

Chapter 2 is devoted to a discussion of the controversial topic of aromaticity, beginning with an historical review of the subject. An interesting section is included on aromaticity criteria which relates the often subjective opinions of several illustrious chemists on this volatile issue. With regard to the theoretical basis for aromaticity, the authors

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