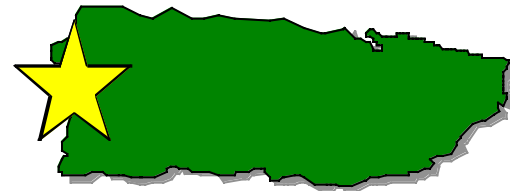


Conference Program

CRC '99



Recinto Universitario de Mayagüez
Mayagüez, Puerto Rico

December 4, 1999

Sponsors:

Center for Computing Research and Development
National Science Foundation
Electrical and Computer Engineering Department, UPR-Mayagüez

Software Research

The President's Information Technology Advisory Committee (PITAC), on its report of this year to the President of the United States entitled "Information Technology Research: Investing in Our Future," defines software as the new physical infrastructure of the information age and presents a recommendation to make fundamental software research and absolute priority, both, for computer systems engineering as well as for applications. It emphasizes the areas of software development methods and component technologies, and human-computer interfaces and interaction. This recommendation comes as a result of the following findings: The demand for software far exceeds the ability of the United States to produce it and very often the product is somewhat fragile. In general, the technologies used to build reliable and secure software are inadequate and the diversity and sophistication of software systems are growing rapidly. Finally, more and more often, common activities of ordinary people are based on software. This year we have chosen, for obvious reasons, the theme of the Computing Research Conference to be Software Research and we thank our keynote speaker, Dr. Javier Arroyo, for sharing with us an aspect of this increasingly important field.

We would like to thank all the participating students and professors for their contribution, through their work and participation, to the success of the CRC '99 Conference, ever improving the quality of the presentations and the diversity of the research efforts. We also would like to thank the Electrical and Computer Engineering Department and specially Ms. Omayra López, Ms. Waleska Campos, and the rest of the staff of the Center for Computing Research and Development (CECORD) for their energy, effort, dedication, and overall contribution in making this event a reality throughout the years. Last but not least, we would like to express our gratitude to the National Science Foundation for their economic support.

Dr. Domingo Rodríguez
CONFERENCE CO-CHAIR

Dr. Néstor Rodríguez
CONFERENCE CO-CHAIR

Program

- 7:30 - 8:30 **Registration** (Stefani 113)
- 8:30 - 9:00 **Welcoming Remarks**
- 9:00 - 10:00 **Keynote Speech** : *Software Engineering: The State of the Profession- Dr. Javier Arroyo*
- 10:00 - 10:30 **Break**
- 10:30 - 12:10 **Oral Presentations** (Stefani 113)
- 10:30 *On Kronecker Products Signal Processing Algorithms and FPGA Computational Structures* (Yvonne Avilés)
- 10:50 *Evaluation of Digital Sound Spatialization Accuracy Over Commodity Audio Channels in a Personal Computer* (Omar Grafals)
- 11:10 *Indexed Web Navigation* (Ariel V. Mirles)
- 11:30 *Wavelet Application to Structural Dynamics* (Anna V. Ovanesova)
- 11:50 *The Effects of Human-Computer Interfaces in Mental Effort, as Measured by Alpha Activity* (Danmary Sánchez)
- 12:10 **Lunch** (Campus Cafeteria)
- 1:30 - 2:50 **Oral Presentations** (Stefani 113)
- 1:30 *A Sar Algorithm Development Environment Using MATLAB®* (Dilia B. Rueda)
- 1:50 *Application of Usability Engineering Methodology in the Analysis, Design, And Implementation of a Graphical User Interface for a Flash Flood Warning System* (Dianne López)
- 2:10 *Genetically Found, Neurally Computed Artificial Features* (Hiram Firpi)
- 2:30 *Twiddle Factor Elimination in Multidimensional FFT's* (Yuitza T. Humarán)
- 2:50 - 3:05 **Break**

3:05 - 5:00 **Poster Presentations**

- *Implementation of "Towers of Hanoi" Algorithm using Cilk 5.2: Parallelizing a Recursive Algorithm* (Heber Irizarry)
- *Wavelet Features for Color Image Classification* (Michael Diaz)
- *Instantaneous Orbits for Binary Asteroids*(Ivelisse M. Cabrera)
- *Calculation of Cycles and Order of Permutations in a CILK Environment* (Néstor Méndez)
- *Cache Conscious Matrix Transpositions and Parallel Implementation* (Javier Hernández)
- *Load Distribution on a Heterogeneous Cluster of Workstations* (José R. Santos)
- *A Parallel Bit Reversal Algorithm and it's CILK Implementation* (Dániza C. Morales)
- *Genetic Algorithms and a Variational Method for Image Denoising* (Luis E. Pérez)
- *A Computational Environment for the Analysis of Discrete Time Discrete Frequency Time-Frequency Signals* (Marlene Vargas)
- *Magnetic Resonance Imaging Heat Deposition In Non-uniform Ellipsoidal Objects* (Rafael R Canales)
- *Approximation of a Differential Equation Using a Combination of Euler and Taylor Methods in CILK Environment* (Francisco Alvarado)
- *Performance Evaluation Methodology for Automatic C-Code Generation of Signal Processing Algorithms* (Joannie Madera)
- *Color Image Classification* (Marcel J. Castro)
- *A Graphical User Interface for Registering Employees Based on Photo Images* (Aixalis González)

5:00 **Conference Closure**

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On Kronecker Products Signal Processing Algorithms and FPGA Computational Structures

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An environment is developed where Kronecker-based signal processing algorithms are translated into equivalent hardware constructs in Field Programmable Gate Array (FPGA) units.

This work focuses on the methodology that establishes the correspondence between Kronecker-based signal processing algorithms and hardware computational structures. Our work also presents the methodology as an alternative technique for modular design of computational structures for signal processing algorithms as well as an efficient framework for rapid prototyping. The work describes the methodology in terms of fast Fourier transform (FFT) algorithms; but, basic principles can be abstracted and generalized.

Evaluation of Digital Sound Spatialization Accuracy Over Commodity Audio Channels in a Personal Computer

Omar Grafals, Navarun Gupta, Gualberto Cremades
Armando Barreto, and Malek Adjouadi
Electrical and Computer Engineering Department
Florida International University

This paper presents an analysis of the accuracy achievable in the spatialization of digital sound using generic head related transfer functions (HRTFs) played back over commodity audio channels readily available in most personal computers (PCs) now in market, using off-the-shelf headphones. We believe that this study is of interest because these are the conditions in which the vast majority of computer users actually experience 3D sound in consumer applications, such as games. Our analysis suggests that under these conditions localization is much less accurate to the sides of the head, and that there is an average localization error of approximately 15° in the azimuth range [-75°, 75°].

Indexed Web Navigation

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The user of the Web browsing application is subject to the limited navigational functionality of the browsing application itself, such as the back button, the forward button and the home button. Besides these three navigation buttons and the bookmark function in the Web browsing application, there are no other navigational aids provided to the user. Because of this limited functionality, users are subject to visiting irrelevant pages while searching for information. This creates unnecessary traffic on the Internet and wastes time. Additional navigation functionality in the Web browser is needed to provide users a more efficient means to navigate the Internet for information. In this paper we proposed the integration of an index button to a Web browser. A custom Web browser with site indexing capabilities through an index button was developed. A group of 30 users were asked to search for information using this browser. Another group of 30 users were asked to look for the same information using a similar browser without the index button. The results of this experiment showed that users of the browser with the index button were able to find information faster, made fewer errors and viewed fewer pages while performing the test. This study showed that users could find information faster by using a browser with site indexing capabilities. The study also demonstrated that the Internet traffic could also be reduced by using this type of browser.

Wavelet Application to Structural Dynamics

Anna V. Ovanesova
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This paper presents the research of the wavelet application for the damage identification in structures. Simply supported beam with a transverse on-edge nonpropagating open crack was chosen as a case of study. The results show that some wavelets were able to detect exact crack location and that regularity is an important characteristic in selecting the appropriate wavelet.

The Effects of Human-Computer Interfaces in Mental Effort, as Measured by Alpha Activity

Danmary Sanchez, Kanij Fatema, Gualberto Cremades,
Malek Adjouadi, Armando Barreto
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Florida International University

This is a case study involving empirical assessments of EEG signals collected using a Neuro Scan Electrical Signal Imaging brain recording system with 256 electrodes (ESI-256). Subjects were used in an effort to determine and contrast the mental efforts associated with given tasks involving different human-computer interfaces. This article demonstrates and confirms that indeed a particular frequency band between 8 and 13 Hz referred to as alpha activity can be used to characterize under different events or conditions the mental effort or activation associated with basic sensory experiences and mental tasks. The results obtained in this study support this assertion.

A SAR Algorithm Development Environment Using MATLAB

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A MATLAB® based environment is presented for signal processing algorithm development targeted to computational intensive image kernel formation in the area of Synthetic Aperture Radar (SAR).

Special attention is given to the development of algorithms for image formation from raw data. Kronecker algebra has been used, as a tool aid for reducing the computational effort in the MATLAB® implementation process of unitary operators, such as the multidimensional discrete Fourier transform, which form an integral part of some of these algorithms. The MATLAB® environment, named SARCSPE, is described in a finite dimensional multilinear algebra framework.

Application of Usability Engineering Methodology in the Analysis, Design, and Implementation of a Graphical User Interface for a Flash Flood Warning System

Dianne López Trujillo, Néstor J. Rodríguez

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In this paper we present a Real-Time Flood Warning System (RTFAS) which integrates information, collected and processed by the United States Geological Survey (USGS) and the Civil Defense (CD) and provides that information to local government agencies. The interface for a Flash Flood Warning System will notify the users about potentially dangerous events happening on rivers and lakes in Puerto Rico. The development of the system is based on the principles of human-computer interaction and usability engineering methodology. This methodology facilitates the preparation of a user-centered, flexible, and robust user interface.

Genetically Found, Neurally Computed Artificial Features

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The specification of distinguishable features is the most important key to intelligent sensing in pattern recognition, but few research results have been reported in the field. We investigated genetically learned artificial features that are customized for a given classification task from a list of raw features. The pioneering work in [6] was significantly extended by representing and computing features by networks. A parallel/non-parallel random vector decision problem and k-nearest neighbor classifiers were used to assess the feasibility of genetically found, neurally computed (GFNC) features. We show how a novel artificial feature quickly evolves to achieve 100% accuracy in this problem.

Twiddle Factor Elimination in Multidimensional FFT's

Yuitza T. Humarán Martínez
Advisor: Dr. Jaime Seguel
Mathematics Department

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A new approach for the computation of multidimensional FFT without twiddlefactors is presented. The procedure uses change of basis in the sample and transform domains to eliminate twiddle factors.

Implementation of "Towers of Hanoi" Algorithm using Cilk 5.2: Parallelizing a Recursive Algorithm

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Department of Mathematics

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The "Towers of Hanoi" puzzle is one of the programs that has been studied, played and coded by many programmers around the world. Due to the magical complexity of the problem different approaches could be presented but some of them are only the ones that get the best achievement to resolve the task. The legend of the Towers of Hanoi appeared in a column of the Scientific American magazine:

"In the great temple of Brahma in Benares, on a brass plate under the dome that marks the center of the world, there are 64 disks of pure gold that the priests carry one at a time between these diamond needles according to Brahma's immutable law: No disk may be placed on a smaller disk. In the begging of the world all 64 disks formed the Tower of Brahma on one needle. Now, however, the process of transfer of the tower from one needle to another is in mid course. When the last disk is finally in place, once again forming the Tower of Brahma but on a different needle, then will come the end of the world and all will turn to dust".

It can be represented as follows: There are 3 needles and a tower of disks on the first needle, with the smaller on the top and the bigger on the bottom. The idea is to move the whole tower to the last needle, by moving only one disk at a time and by observing not to put a bigger disk atop of a smaller one. To solve the problem we could use a recursive procedure. We want to show the different behaviors between a serial code and a parallel code in a 4-Processor computer running Linux (Kernel: 2.2.10). This last one written in CILK 5.2. The solution of the Hanoi Towers Problem is inherently recursive. Although recursive algorithms usually translate a serial code, the particularities of the Cilk environment allowed us to produce a higher parallel method.

Wavelet Features for Color Image Classification

Michael Diaz

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In this paper, we compare the performance of three different wavelet methods for color texture classification. Wavelet transforms are useful for extracting texture features of images. These features are used for texture recognition, and constitute energy, entropy values of sub-images computed using Pyramid structure Wavelet Transform (PWT) or tree structured Wavelet Transform (TWT). As color images have 3 channels compared to 1 channel in gray scale images, they can be exploited for the additional information they can provide.

The algorithm consists of transforming the RGB color space to xyY color space and the features are computed in this space. The reason for using this space is that they provide chrominance and luminance information of the color images. The sub-band filtering is performed in particular channels depending on the histogram of the chrominance values. This reduces the computational cost, since only a few sub-bands need to be decomposed at each stage. Results of classification using photographic color textures are presented and discussed in this paper.

Instantaneous Orbits for Binary Asteroids

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We developed the theoretical framework for the calculation of orbits for a binary system, consisting of a spherical and a non-spherical objects. A computer program was written for the special cases where the non spherical body is a prolate spheroid. A particular trajectory is presented.

Calculation of Cycles and Order of Permutations in a CILK Environment

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Permutations of finite sets are used in every branch of mathematics and they have a myriad of applications in science and technology. All permutations are divided in cycles, and these cycles are, in a certain sense, the most basic kind of permutations. This work deals with the development of an algorithm, in a CILK environment, that creates a random permutation and calculate its cycles and order. The assumption is that in a parallel environment the execution of the program with the same parameters will be shorter compared to a serial environment.

Cache Conscious Matrix Transpositions and Parallel Implementation

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Time is important, nowadays. In computer programming time is crucial. The speed of processing large amount of data is today's major bottleneck in several scientific and engineering applications. One solution of this problem could be to take advantage of the software and the hardware to improve the time required for processing data.

Maximizing the hardware capabilities and developing parallel algorithms are probably solutions to the problem of reducing the time of processing the information.

Load Distribution on a Heterogeneous Cluster of Workstations

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Clusters of workstations are becoming very popular because of their price performance advantages over super computers from Cray and IBM. Although programming clusters is not very complicated, some considerations should be taken when the execution is intended for a cluster of heterogeneous workstation. In fact, just dividing the amount work equally among different types of workstation might not yield optimal performance since different CPU process data faster than others. This work deals with design considerations for C code with MPI. The idea is developing code that distributes the workload not only by the number of processors in the cluster but also, the processing power of each CPU.

A Parallel Bit Reversal Algorithm and it's CILK implementation

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A wide variety of Fast Fourier Transform (FFT) algorithms employ a bit reversal method for the reordering of input or output data. This article shows one of the most frequently used algorithms for calculating the bit reversal permutation. It also presents a parallel implementation in CILK 5.2 and some performance analysis.

Genetic Algorithms and a Variational Method for Image Denoising

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Variational methods for image denoising consist of minimizing a functional which incorporates both the data and some penalty term. Choosing the penalty term to involve the total variation of the image has the advantage of cleaning speckles without smoothing out the edges. Our goal is to investigate the use of genetic algorithms to minimize the functional.

A Computational Environment for the Analysis of Discrete Time Discrete Frequency Time-Frequency Signals

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There are several engineering and scientific areas where the development of meaningful applications require the analysis and design of signals whose spectral characteristics change with respect to time. The tools used to treat these signals are known as "time-frequency tools". This on going work presents the development of a computational environment that makes a uniform characterization of time-frequency signal analysis tools through a MATLAB environment to study the spectral content of time-varying signals on a specific applications.

Magnetic Resonance Imaging Heat Deposition in non-uniform ellipsoidal objects.

Rafael R Canales, Luis F Fonseca, Fredy R Zypman
University of Puerto Rico

In this work we compute the Specific Absorption Rate (SAR) of a radio frequency fields in ellipsoidal geometries representing regions of the human head under Magnetic Resonance Imaging (MRI) studies. The E & M fields were calculated by the T-Matrix algorithm. The SAR presented here show strong conductivity and resonance effects.

Approximation of a Differential Equation using a Combination of Euler and Taylor Methods in CILK Environment

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In this paper we introduce a parallel method for computing a discrete set of approximate values of the solution of an initial value problem. A differential equation is said to be an equation containing the derivatives of one or more dependent variables, with respect to one or more independent variables.

Using CILK to find solutions to differential equations will result in more exact approximations and faster results.

Performance Evaluation Methodology for Automatic C-Code Generation of Signal Processing Algorithms

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In this paper, we present a methodology of the performance evaluation of source C-code produced using two types of automatic code generation tools. The generation tools have been studied in detail and their product have been analyzed from the point of view of code length, time performance, code legibility and explicitness, computational stability, and code portability and reusability. An evaluation methodology is proposed and tested using fast Fourier transform (FFT) algorithms as automatic generated product codes. This is an ongoing work and some initial recommendations are provided as a result of our findings through our research work.

Color Image Classification

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This paper describes the process of classifying color images based on color texture information. The images are originally in Red-Green-Blue (RGB) and they are changed to xyY to facilitate the image processing. Chromacity information (xy) is combined with luminance (Y) in the image. The process analyzes them separately to finally use them both together to classify the image. Luminance information is processed in three stages: filtering, smoothing, and boundary detection. Chrominance information on the other hand, is processed in one stage: histogram multi-thresholding. Luminance and chrominance image processing implementation is included in this paper. Classification is done using luminance part after Gabor filtering and calculating average features. Results are presented for 6 color images.

A Graphical User Interface for Registering Employees Based on Photo Images

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Employees absenteeism is a problem that could go undetected on some workplaces such as the construction industry. Some workplaces lack accurate methods for accounting the number of hours worked by employees. These problems can be solved by adopting technology for the automatic recognition of people. There exist various methods based on fingerprint, voice recognition, retinal scanning, palm printing, thermal imaging of the face, and fingernail or nail plate. Most of these methods rely on complex pattern recognition techniques and therefore are usually expensive. We proposed a solution based on photo images. The proposed method is not an automatic recognition method. It is a relatively inexpensive method that requires human intervention in the recognition process. A prototypes is being developed. Once the prototype is operational a study will be conducted to determine the recognition accuracy and the acceptance of the method by potential users.

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