Report III

May 2002

PRECISE

University of Puerto Rico at Mayagüez (UPRM)
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NSF GRANT #99-77071

Progress Report: AY2001/2002

PRECISE Project Background

UPRM NSF PRECISE (NSF EIA 99-77071) has as principal goal to facilitate, enhance and strengthen the current research environment in CISE at UPRM, making it more diverse, competitive and sustainable. It will also help in implementing the UPRM Ph.D. CISE model as an academic program. Together with previous CISE grants, this project continues to work with professors and students in CISE areas to become a model program for minority-serving institutions in an effort to enter the competitive research and development mainstream. We can identify three (3) phases or levels of this model, namely:

PRECISE, Phase I: **(first CISE grant)** Enhance BS degree in Computer Engineering, develop infrastructure and start developing MS degree.

PRECISE, Phase II: **(second CISE grant)** Enhance infrastructure and R&D in CISE and initiate development of Ph.D. in CISE.

PRECISE, Phase III: (current CISE grant*): ***Entering the R&D Mainstream: Changing the Local Research Culture***.** Approve Ph.D. program, enhance infrastructure and firmly establish R&D Groups (set R&D goals/ objectives, obtain competitive grants, publish papers in peer-reviewed journals, establish strategic alliances with other institutions and research groups, participate in CISE review panels, work with industry, etc.)

The PRECISE Project has five (5) major tasks with specific goals and objectives as outlined in its strategic plan:

- Establishment of Solid Research Groups in CISE areas
- Graduate MS and Ph.D. Student Training
- MS & Ph.D. Recruitment
- Outreach to Industry, Academia, and Government
- Automated Assessment of Project Activities

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Part A: Accomplishments - PRECISE's SUCCESS STORIES

Introduction:

We present below some of the success stories of the PRECISE Project (NSF EIA 99-77071) which would have been almost impossible to accomplish without the current CISE MII Grant. The PRECISE Project started in August 1999 and obtained 100% matching funds from the University of Puerto Rico.

1. 0 Ph.D. in CISE

The Ph.D. Program in Computing and Information Sciences and Engineering (CISE) has been a central theme of the PRECISE Project. Through this Ph.D. Program we seek to increase the participation of women and minorities in graduate education. The Ph.D. in CISE officially started in the Spring 2001 Semester. At this moment the program has twelve students, three of them currently being fully supported by the PRE-CISE Project.

1.1 CISE Ph.D. Main Objectives

- To form investigators with a high level of excellence in computing and information technology. The program's graduates will be enabled to evolve as much in industry as academia, and will be conscious of the roll of the investigation in social and economic development, of its social impact, and of its related ethical subjects.

- To serve as catalytic center to propel and sustain advanced interdisciplinary studies. The program was conceived as an open and dynamic interdisciplinary entity, designed to incorporate an ample range of options for scientific research creation and technological innovation, and to facilitate the adaptation to the changes that requires any discipline in evolution.

> cise_phd
Computing and Information Sciences and Engineering, Ph.D.

Ph.D. CISE Welcome and Orientation Meeting
September 20, 2001—UPRM – Eugene Francis Conference Room

> cise_phd
Computing and Information Sciences and Engineering, Ph.D.

The program is endowed with enough flexibility to accommodate a wide spectrum of applicants with degrees in sciences, engineering, and mathematics. The diversity of options offered allows the satisfaction of both, scientific or technologically oriented applicants, and fosters the generation of interdisciplinary projects for the advancement of knowledge and social and industrial development. The program is also open to collaborations with other graduate programs. As an example of this type of collaboration, a group of researchers in the area of high performance computing is supporting the development of a bio-informatics area in the newly proposed PhD program in biotechnology at UPRM. The doctoral program in CISE represents the natural evolution of the programs of Masters in Computer Engineering and Masters in Mathematics, specialty in Computational Mathematics.

1.2 Students

The doctoral program in CISE has been very welcomed by students across Puerto Rico. An average of three weekly requests for information have been received at the program office. These requests include calls from the United States, Colombia, Venezuela, and Mexico.

The Program's Graduate Affairs Committee has evaluated forty-two applications that have been completed and referred by the Office of Graduate Studies. From these, the Committee has accepted a total of fifteen applicants. Twelve applicants have officially entered the program, ***eight of them males*** and ***four females***. Among the students that did not registered in the program, at least one of them is expected to register the next semester. According to preliminary information issued by the Office of Graduate Studies, the number of new applicants to the program will be equal or higher for the Fall 2002 semester.

NAME	SEMESTER	SPECIALTY	SUPPORT	PREVIOUS DEGREE
Vidya Manian	III	Computer Sciences and Engineering	PRECISE	MS. Computer Eng.
José Vega	III	Scientific Computing	ARMY	MS. Mathematics
Esov Velázquez	III	Computer Sciences and Engineering	N / A	Ph.D. Physics
Miguel Cortés	III	Computer Sciences and Engineering	N / A	MS. Computer Eng.
Yolanda Peña	III	Computer Sciences and Engineering	PRIDCO	MS. Computer Eng.
Ricardo Infante	II	Scientific Computing	Requested for Next Sem.	MS. Chemistry
Edusmildo Orozco	II	Scientific Computing	PRECISE	MS. Mathematics
Luis Ortiz	II	Computer Sciences and Engineering	Requested for Next Sem	MS. Computer Eng.
Juan Solá	II	Computer Sciences and Engineering	PRECISE	MS. Computer Eng.
Lida Jáuregui	II	Scientific Computing	CPES	MS. Electrical Eng.
Karen Cotto	I	Computer Sciences and Engineering	N / A	MBA
Shiyun Wen	I	Computer Sciences and Engineering	Institutional (UPRM)	Ph.D. Biology

1.3 Doctoral Faculty

The UPR-Mayagüez, offered special conditions to a group of professors whose compromise with the program was in agreement with the so called Strategic Plan for the Development of CISE at UPRM (Appendices I & J of the Proposal for the Establishment of the Doctoral Program in CISE at the UPR). This faculty was selected from applications submitted to the Graduate Affairs Committee of the program. The professors selected so far are:

1. Dr. Edgar Acuña
2. Dr. Dorothy Bollman
3. Dr. Lev Steinberg
4. Dr. Jorge Ortiz
5. Dr. Pablo Tarazaga
6. Dr. Wilson Rivera

1.4 Projections of the Ph.D. Program

- **Expansion to the UPR System**. Currently the Graduate Affairs Committee of the program is evaluating a proposal submitted by the Coding Theory Group of the Department of Mathematics and Computer Science of the Arts and Natural Sciences College of the UPR-Rio Piedras. This proposal is pending the definition of its approval channels from Central Administration to proceed. In addition, the program contemplates academic collaborations with other departments of the University of Puerto Rico.

- **Relations with PR government.** The program is conducting meetings and activities that seek to enhance its consistency with the governmental strategies for the economic development of the Puerto Rican society. In particular, the doctoral program in CISE seeks to align its research directions with those of the Techno-Economic Corridor of PR (PRTEC), collaborating with the common aim of bringing the country to a competitive level in areas such as Communications and Information Technology within a global economy.

- **Puerto Rico as an internationally recognized center for CISE Research & Development.** The program seeks to consolidate its model as an interdisciplinary graduate education entity, capable of developing the island talents, both academically and in their entrepreneurial dimensions to promote the advancement of science and its impact on the economic and social development of the country.

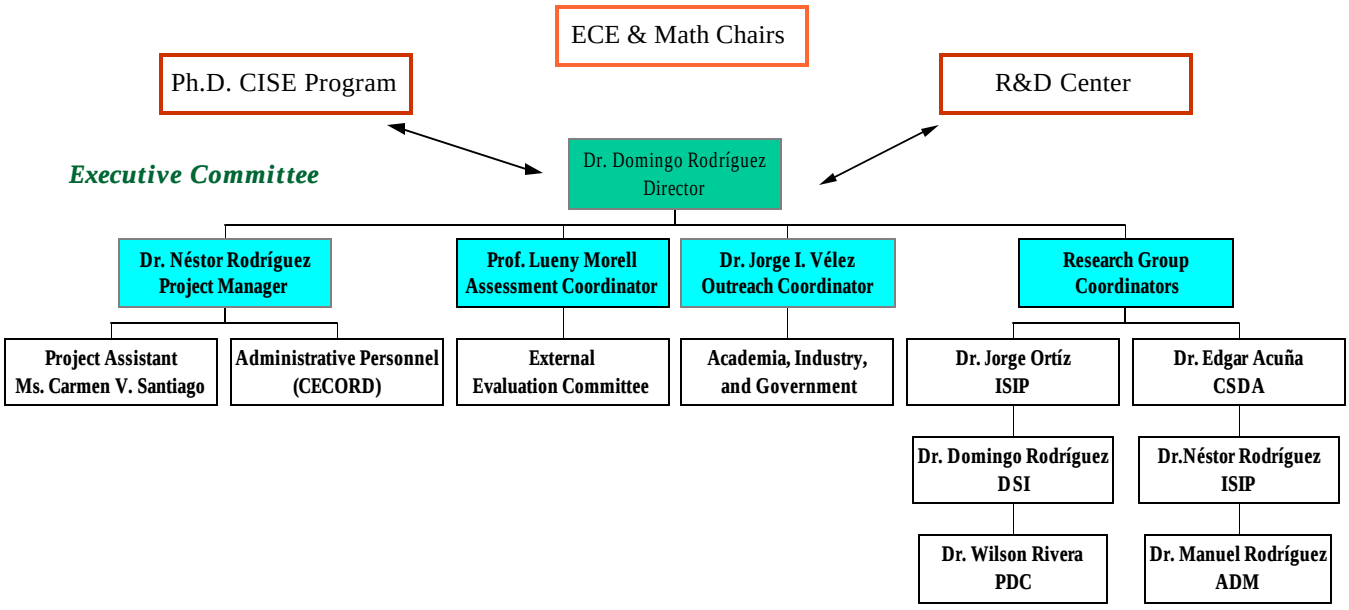
Towards Functional Dependencies for XML Documents Conference by Dr. Héctor J, Hernández, Associate Professor in Computing Sciences at Texas Tech University.

2.0 New Facilities: Ph.D. & CECORD

After a remodeling project lasting about six months, and funded by our university through matching funds, we proceeded to relocate to the new facilities housing the administrative offices of our Ph.D. CISE Program and the Center for Computing Research and Development (CECORD), where we manage the PRECISE Project. These new facilities are located in the main building of the R&D Center and provide office space for the Director of the Ph.D. CISE Program. Ph.D. Program Assistant, and secretary; the PI and the manager / CoPI of the PRECISE Project, PRECISE Project assistant; and secretary; CECORD Project Assistant, in charge of other projects managed by CECORD, and assistants (students in training) from the School of Business Administration.

At the same location we created a lounging facility for our doctoral students, including individual cubicles equipped with workstations for general work and Internet access. The lounge has a maximum capacity of twelve (12) students.

PRECISE's Management Structure



3.0 Research Laboratories

3.1 Computing Research Laboratory (CRL)

A Computing Research Laboratory (CRL) was established during the first semester of the 2000/2001 academic year. This laboratory is currently providing working space to all professors and students directly participating in the PRECISE Project. The Laboratory is also open to any graduate student conducting research work in any CISE area. At the present time there are more than 80 people using the Laboratory on a 24-hour basis. Priorities for the use of the Laboratory have been set according to guidelines of the PRECISE Project.

3.2 Rapid Systems Prototyping (RASP) Laboratory

This Spring 2002 semester we established a new research laboratory associated to the Digital Systems Implementation Group. Below we describe the vision, mission, professors and outcomes associated with this newly created lab which we named Rapid Systems Prototyping.

Vision
The Rapid Systems Prototyping (RASP) Laboratory has a its vision to develop the most advanced environment for rapid systems prototyping at the university level in Puerto Rico.

Mission
The main mission of the RASP Laboratory is to enable graduate students acquire the necessary training, skills, expertise, and capabilities to conduct academic and industrial research work in the field of rapid prototyping digital-based systems, in general, and digital signal processing systems, in particular.

Research Groups and Professors
At the present time the laboratory is being utilized primarily by the Digital Systems Implementation (DSI) Group, of the PRECISE Project (http://www.precise.ece.uprm.edu). This group is conformed by the professors Isidoro Couvertier, Manuel Jiménez, and Domingo Rodríguez. Other professors using the RASP Laboratory include Professor Rogelio Palomera and Professor Ramón Vásquez.

3.3 Hardware/Software Prototype Outcomes

Prof. Manuel Jimenez has synthesized two new scalable cores for field programmable gate array (FPGA) units. The cores, one to perform floating point multiplications and the other one to perform floating point additions, were first designed and developed using the VHDL language and then mapped to Xilinx FPGA units.

Prof. Domingo Rodriguez has designed and developed a new algorithm for the efficient computation of the discrete Fourier transform (DFT). The algorithm has been designed to compute the DFT of discrete signals of length n where n is a composite of the form "n = 4p" and "p" any prime number. The algorithm was implemented on the TI 6711 floating point DSP unit, taking advantage of specialized signal processing software instructions. One of the advantages of this new algorithm is the manner in which it handles twiddle or phase factors at a single stage in the data flow instead of the traditional format of multistage twiddle factor computation.

4.0 PRECISE's Publications

Below we present the publication outcomes for the PRECISE Project for the past year, starting on April 1, 2001.

4.1 Journals

1. **E. Acuña**, and A. Rojas, "Bagging classifiers based on kernel density estimators". Proceedings of the International Conference on New Trends in Computational Statistics with Biomedical Applications, August 2001, pp 343-350 (an extended version of this paper will appear on the Journal of The Japanese Society of Computational Statistics by the end of this year).
2. **E. Acuña**, and A. Rojas, "Combining classifiers based on kernel density estimators". Bulletin of the International Statistical Institute, August 2001, Tome LIX, Book2 pp 17-19.
3. **Bollman**, J. Seguel, J. Feo - "A functional Approach to Radix-r FFTs". Progress in Computer Research, Vol. I, Ed. F. Columbus, Nova Science Publishers, 2001, pp 77-103.
4. **D. Bollman**, and E. Orozco, "A Faster Algorithm for the n-Queens Problem", To appear in Congressus Numerantium 2001.
5. **W. Rivera**, J. Zhu, and D. Huddleston, "An efficient parallel algorithm for solving unsteady Euler equations," Parallel Computational Fluid Dynamics: Recent Development and Advances, Elsevier Science. Accepted May 18, 2001.
6. **W. Rivera**, "Stability analysis of numerical boundary conditions in domain decomposition algorithms," Journal of Applied Mathematics and Computation, Accepted December 2001.
7. **W. Rivera**, "Numerical interface conditions for non-overlapping domain decomposition algorithms," Journal of Parallel and Distributed Computing. Submitted December 2001.
8. **J. Seguel**, D. Bollman, E. Orozco - New Prime Edge-Length Crystallographic FFT. To appear in Lecture Notes of Computer Sciences, ELSEVIER.
9. **J. Seguel** - A Unified Treatment of Symmetric FFT Code Generation. Conditionally accepted for publication in IEEE Transactions on Signal Processing.
10. **L. Steinberg**, and A. Hurd, "The Physics of evaporation-induced assembly of sol-gel materials", The Journal of Granular Matter 3, pp 19-21, Springer-Verlag 2001.
11. **L. Steinberg**, "Mesoscopic Resonance of Self-Excited Defect", Proceedings of Dynamic Systems& Applications, Volume 3, 2001, pages 569-576.
12. **V. Manian** and R. Vásquez, Approaches to color and texture based image classification, Journal of Optical Engineering, SPIE, accepted 2002.

4.2 Refereed Conferences (with proceedings)

1. **S. L. Cruz Pol**, N. Colón and S. Sekelsky, " Multidimensional Cloud Images Retrieval From Dual- Frequency Millimeter-Wave Radar ", IGARSS 2001 Sydney, Australia, July 2001.
2. **M. Jiménez**, M. Shanblatt, "Integrating a Low-Power Objective into the Placement of Macro Block-based Layouts," Proceedings of the IEEE. Midwest Symposium on Circuits and Systems, pp. 62-65, Ohio, Aug. 2001.
3. **M. Jiménez**, D. Rodriguez, N. Santiago, "Scalable Floating Point FPGA Cores for Digital Signal Processing," Proceedings of the Annual Automatics, Instrumentation and Industrial Electronics Conference (SAAEI 2001) , CUBA, September 2001.
4. **M. Jiménez,** M. Shanblatt, "A Low-power Approach to the Placement of Macro Block-based VLSI Layouts," Proceedings of the Annual Automatics, Instrumentation and Industrial Electronics Conference (SAAEI 2001) , CUBA, September 2001
5. **V. Manian** and R. Vásquez, A genetic Algorithm for Texture Description and Classification, Preceedings of AeroSense '02, April 2002.
6. **J. L. Ortiz,** 2001 "Fuzzy Syntactic Parser for Command Language Recognition Under Adverse Conditions", I/ITSEC (Interservide /Industry Training, Simulation and Education Conference) Orlando, FL. Nov 2001.
7. **W. Rivera**, J. Zhu, and D. Huddleston, "Parallel performance investigation of a domain decomposition algorithm", Proceedings of the Tenth SIAM Conference on Parallel Processing for Scientific Computing. Portsmouth, Virginia, 2001. (SIAM ISBN 0-89871-492-3)
8. **W. Rivera**, J. Zhu, and D. Huddleston, "An efficient parallel algorithm for solving unsteady nonlinear equations", Proceedings of the International Conference on Parallel Processing Workshops, Valencia, Spain, 2001, IEEE Computer Society, pp 79-84.
9. **W. Rivera**, "Adaptivity Support For Computational Grid-Aware Clusters," 6th World Multiconference on Systemics, Cybernetics and Informatics (SCI2002) to be held in Orlando, in July 14-18, 2002.
10. **D. Rodriguez**, "A Computational Kronecker-core Array Algebra SAR Raw Data Generation Modeling System," IEEE 35th Asilomar Conference on Signals, Systems, and Computers, Nov. 2001, Monterrey, California.
11. **D. Rodriguez**, "Signal Algebra Operators for SAR PSF Hardware Computations," 2002 AIRSAR Earth Science and Applications Workshop, NASA Jet Propulsion Laboratory, Pasadena, California, March 2002.
12. **D. Rodriguez**, D. Rueda, H. Nava, A. Quinchanegua, "High Performance SAR Raw Data Generation Algorithms for Remote-sensed Imaging Applications," IEEE IGARSS 2002, Toronto, Canada, July 2002.
13. **D. Rodriguez**, A. Quinchanegua H. Nava, "Signal Operator Cores for SAR Real Time Processing Hardware," IEEE IGARSS 2002, Toronto, Canada, July 2002.
14. **N. J. Rodriguez**, Murillo, V., Borges, J.A., Sands, D.Z., and Ortiz, J. A study of physicians' interaction with text-based and graphical-based electronic patient record systems. Proceedings of the 15th. IEEE International Symposium on Computer-Based Medical Systems, June 2002.
15. **B. Vélez**, J. E. Valiente, "Interactive Query Hierarchy Generation Algorithms for Search Result Visualization," Proceedings of Internet and Multimedia Systems Applications (IMSA 2001)
16. **B. Vélez**, J. A. Torres, "Anticipatory User Interfaces for Search Result Visualization using Query Lookahead," Proceedings of Americas Conference on Information Systems (AMCIS 2001) Best Paper Award
17. **M. Jiménez,** R. Palomera, and M. Toledo, "Undergraduate Research and Co-op Education: A Winning Combination", To appear in Frontiers In Education, FIE-2002, Boston, MA, Nov. 2002.
18. J. Navarro, J. Borges, and **M. Jiménez**, "Electronic Academic Counseling System", To appear in Frontiers In Education, FIE-2002, Boston, MA, Nov. 2002.

AWARDS:

Lev Steinberg CoPI, DOE-EPSCOR Grant on "Material Architecture." Started in May 2001. (Total: $1,500,000.00).

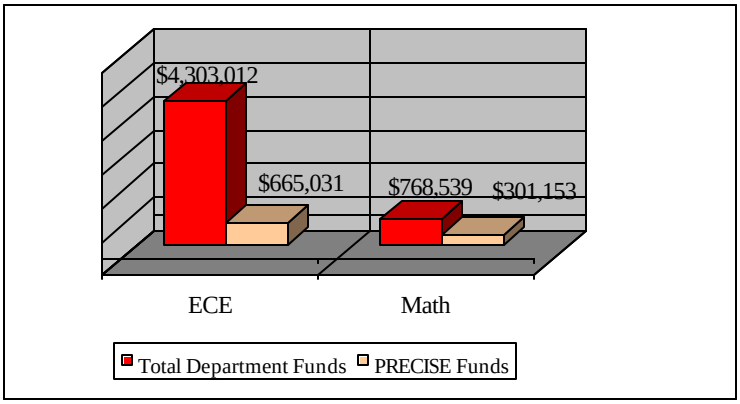
5.0 Competitive Grants

In this section we present a list of on going competitive grants by research collaborators in the PRECISE Project. The set of grants, totaling more than $3,000,000, provides an example of the degree and nature of research activity being supported in part by the infrastructure provided by this CISE Grant.

PI and Co-PI's	Title	Funding Agency	Grant Period	Total Funds
E. Acuña	Combining Classifiers Involving Kernel Density Estimates and Gaussian Mixtures	Office of Naval Research	March 2000 - Feb. 2003	$200,000
J. Arroyo N. Rodríguez,(CoPI) J. Borges (CoPI)	An Event-Rule Framework for Supporting Heterogeneous Distributed Systems	NSF	1999-2002	$499,000
D. Bollman Jaime Seguel (CoPI)	A Universal Package for Crystallographic FFTs	NIH	1999-2002	$248,079
J. Gonzalez D. McGee (CoPI) A. San-Juan (CoPI)	Water Quality and Marine System Indicators: Development of a Statistical Model for an Integral Assessment	NOAA	June, 2002 - June, 2004	$181,639
D. Mcgee Vasquez (CoPI) Cáceres (CoPI) Martinez-Planel (CoPI)	Web based Technology for Calculus	Dept. of Ed.	Oct. 2000 - Oct. 2003	$230,000
Daniel McGee Martinez-Planell (CoPI)	Visualization Tools for 3d	NSF	Jan. 1999 – Dec. 2001	$75,000
Martinez-Planell D. McGee (CoPI)	Precalculus for Engineers	FIPSE	Oct. 2000 - Oct. 2003	$326,000
R. Vasquez H. Parsiani (CoPI) L. Sirda (CoPI)	Soil Moisture Content Extraction, Using Images from Ground Penetrating Radar	NOAA	Oct. 2001 – Oct. 2004	$1,200,000
B. Velez J. Arroyo (CoPI)	O2S2	IBM	Jan. 2001 - Dec. 2001	$70,000

4.1 Renewal Grants

E. Acuña	Combining Classifiers Involving Kernel Density Estimates and Gaussian Mixtures	Office of Naval Research	Oct. 2003 – Sept. 2005	$220,000



The graphic shows this year's proportion in dollar terms, of the grants where PRECISE researchers are PI or Co-PI's. PRECISE Researchers manage 15% of the Electrical and Computer Department grants. On the other hand, 39% of the Mathematics Department grants are of the researchers in our project.

5.0 Research Collaborators and Students

5.1 Students in the PRECISE Project

The PRECISE Project has a strong commitment with increasing the number of women and minorities going into graduate school. As presented by the 2000/2001 CRA Taulbee Survey Results, "*current and future Ph.D. output will not satisfy demand for faculty*." We feel that fostering a research environment for students to excel and creating a pipeline for our recently approved Ph.D. program are steps in the right direction towards strengthening our model for education in CISE. Currently, we are fully supporting a total of 24 graduate students (three at the Ph.D. level) as research assistants with funds provided by the PRECISE Project. It is important to point out that at present time the great majority of the assistantships provided by the University of Puerto Rico at Mayagüez are for teaching.

5.2 Research Collaborators in the PRECISE Project

We have a total of eighteen (18) professors in the PRECISE Project, who have formed small groups among them for research collaboration. It is our strong believe that this action will facilitate, strengthen, and enhance the research work in Computing and Information Sciences and Engineering at the University of Puerto Rico, Mayagüez Campus, resulting in an increase in the number of graduate students in the Project, more publication work, and more competitive funding, among other things. The groups are: Digital Systems Implementation, Software Sciences and Engineering, Computational Statistics and Data Analysis, Advanced Data Management, Intelligent Systems and Image Processing, and Parallel and Distributed Computing. In the next section we present a complete list of the names of the professors and students forming, at the present time, the core of research collaborators belonging to the PRECISE Project. We then proceed to provide a detailed description of each of the research groups forming part of the PRECISE Project.

5.3 PRECISE Collaborators and Students by Research Groups

Computational Statistics and Data Analysis (CSDA)	
Faculty	**Students**
Prof. Edgar Acuña (Coordinator)	
Prof. Daniel Mcgee	Elisa Maldonado **(MS)**
Prof. Lev Steinberg	César Echevarría **(MS)**

Software Sciences and Engineering (SSE)	
Faculty	**Students**
Prof. Néstor Rodriguez (Coordinator)	Viviam Murillo **(MS)** Yajaira Soler **(MS)** Yeida Rodríguez **(MS)**
Prof. Javier A. Arroyo	Edwin Moulier **(MS)**
Prof. José Borges	Luis Ortíz **(Ph.D.— Summer 2002)**

Advanced Data Management (ADM)	
Faculty	**Students**
Prof. Manuel Rodríguez (Coordinator)	Irvin Ortíz **(MS)**
Prof. Bienvenido Vélez	Jairo Elías Valiente **(MS)** José Torres **(MS)**
Prof. Pedro Rivera	

Parallel and Distributed Computing (PDC)	
Faculty	**Students**
Prof. Wilson Rivera (Coordinator)	Freddy Martín Pérez **(MS)**
Prof. Dorothy Bollman	
Prof. Jaime Seguel	Edusmildo Orosco **(Ph.D.)** Daniel Burbano **(MS)** Armando Vega **(MS)**

Digital Systems Implementation (DSI)	
Faculty	**Students**
Prof. Domingo Rodriguez (Coordinator)	Alberto Quinchanegua **(MS)** Hilaura Nava **(MS)**
Prof. Manuel Jiménez	Irvin Ortiz **(MS)**
Prof. Isidoro Couvertier	Juan M. Solá **(Ph.D.)**

Intelligent Systems and Image Processing (ISIP)	
Faculty	**Students**
Prof. Jorge Ortiz (Coordinator)	Moraima Valle **(MS)**
Prof. Hamed Parsiani	Tolstoy Leonid **(MS)**
Prof. Ramón Vásquez	Vydia Manian **(Ph.D.)**

Part B: Core Research Collaborators - PRECISE's GROUPS

1.0 Computational Statistics and Data Analysis Group

Edgar Acuña, edgar@math.uprm.edu, ***Coordinator***
Daniel Mcgee, mcgee@cs.uprm.edu
Lev Steinberg, levst@math.uprm.edu

1.1 Description

This group is dealing with research work in two areas:

1) Computational Statistics: where we look for the explicit impact of computers on statistical methodology, such as: algorithms, computer graphics, computer intensive inferential methods, expert systems, neural networks, parallel computing and statistical databases.
2) Statistical Methodology for data analysis, where we explore for new data analysis strategies and methodologies such as: classification, data exploration, density estimation, design of experiments, pattern recognition/ image analysis and robust procedures, comparison of statistical methodology and simulation of experiments.

1.2 Current Participation in Competitive Research Grants

- "Combining Classifiers Involving Kernel Density Estimates and Gaussian Mixtures", Sponsored by Office of Naval Research (Edgar Acuña)
- "Visualization Tools for 3d", Sponsored by NSF (D. McGee, Martinez-Planell (Co-PI))
- "Water Quality and Marine System Indicators: Development of a Statistical Model for an Integral Assessment", Sponsored by NOAA (J. González, D. McGee (Co-PI), and A. San-Juan (Co-PI)).
- "Web Based Technology for Calculus", Sponsored by Dept. of Education (D. McGee, Vazquez (Co-PI), Cáceres (Co-PI), Martinez Planel (Co-PI))

1.3 Strategic R&D Alliances with other Institutions

Medical University of South Carolina: Barbara Tilley, Zhen Zhang
Navy Laboratory at Virginia: David Marchette and Jeffrey Solka.

1.4 Research Summaries

Improvement of Supervised Pattern Recognition Techniques - Prof. Edgar Acuña

The research deals with the use of computer intensive methods in statistics to improve supervised pattern recognition techniques. Computer intensive methods involve three aspects: First, the use of powerful computers including parallel computers. Second, the development of efficient algorithms to carry out the procedures, and Third, the programming to perform the algorithms with accuracy and minimizing the running time. Supervised pattern recognition has plenty of applications, but we are more interested in engineering and biomedical (Bioinformatics) applications. The expected research outcomes are:

a) Feature selection for classifiers based on Kernel density estimation. This part will be the master thesis of my student Zoraida Morales and it started in august 2001.
b) Improvement of classifiers based on Gaussian Mixtures through the use of bagging and boosting. This kind of classifiers has a lot of applications even in unsupervised pattern recognition and involves parallel computation. This part will be the master thesis of my student Luis Daza and it started in august 2001. This work will be extended by my doctoral student Jose Vega in his thesis.
c) Applications to genomics of improved classifiers based on Kernel density estimators and gaussian mixtures.

d) Improvement of Support Vector Machine through the use of bagging and boosting. This a new kind of classifiers but has gained a lot of attention very quickly. I am planning to use two students for this part. My students Frida Coaquira and Elio Lozano will be working during the year 2002 in this project and it will be their master thesis. Both of them are planning to continue doctoral studies in CISE.

Quantum Computation and Modeling in Material Science— Prof. Lev Steimberg

Topic 1. Quantum Information & Computation

Over the past 40 years there has been a dramatic miniaturization in computer technology. In several years the basic memory components could be the size of individual atoms. At such scale a new field called quantum computing is emerging. Based on these ideas some new algorithms have been developed. One of the most impressive is Shore's algorithm. The research will be focused on application of the Grover iteration method for quantum database search. This method we will apply to the development of effective quantum algorithms for the Queens problem. Also we will continue review the state of art in quantum computers.

Topic 2. Computer Modeling and Simulation in Material Sciences

Here we will study application of the Cosserat continuum for mechanical systems. As an example, we study nonlinear transport equation, which analytical generalized solution is invariant to the speed of the transport phenomena. The computer modeling of the stable solution is associated with time-space scalability restrictions. We will test instability at the level of a continuum model by involving the space-time dislocation structure. It will be also to study property of the general solution and its relationships with self-organization and scalability problems.

Bioinformatics—Prof. Daniel McGee

The research is conducted in coordination with the BioInformatics Department of the Medical University of South Carolina and concentrates on the application and development of Bioinformatics techniques when applied to medical and educational databases. In particular, neural networks, cluster analysis, genetic algorithms, principal component analysis, and normal statistical methodologies will be used and improved upon in these environments.

Goals:

a) Made significant improvements to the training process for neural networks when used on medical and educational databases
b) Compare the effectiveness of neural networks with traditional methods when applied to medical databases.
c) Establish the degree to which and the method by which the dimensionality of large records in medical or educational databases may be reduced.
d) Obtain clusters within medical and educational fields to identify endpoints or classes with which records may be associated.
e) Create an overall system to analyze medical and educational databases that will obtain the minimum necessary dimensionality per record, will obtain appropriate endpoints with which records may be associated, will train in a considerably expedited fashion neural networks that will obtain the probability that a record should be associated with a given endpoint.

1.5 Publications

E. Acuña,. and Rojas, A. (2001) Combining classifiers based on kernel density estimators. Bulletin of the International Statistical Institute. Tome LIX, Book 2. p17-18.

E. Acuña,. and Rojas, A. (2001). Bagging classifiers based on kernel density estimators. Proceedings of the International conference in Computational Statistics with Biomedical applications. p 342-350. To appear in the next issue of the Japanese Journal of Classification.

L. Steinberg, and Hurd, A. The Physics of Evaporation-Induced Assembly of Sol-Gel Material, Journal of Granular Matter, Springer, 3 1/2. 2001, 19-21.

L. Steinberg, "Mesoscopic Resonance of Self-Excited Defect", Proceedings of Dynamic Systems & Applications, Volume 3, 2001, pages 569-576.

2.0 Digital Systems Implementation Group

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Isidoro Couvertier, icouver@ece.uprm.edu

2.1 Description

The Digital Systems Implementation (DSI) Group has as main objective to conduct basic and applied research in the design and development of efficient rapid systems prototypes for digital electronics applications . Special attention is given to prototypes for digital vector testability for large scale digital designs, FPGA development for emulation and simulation of signal processing computing methods, and the development of Integer Representation-based CAD tools. Target applications include remote sense imaging circuits, coding and cryptography systems, wavelength division multiple-access (WDM) communications circuits, and other large scale computing applications in Signal Processing and Communications. This research group is associated with newly created RASP Laboratory. A main mission of the RASP Laboratory is to enable graduate students acquire the necessary training, skills, expertise, and capabilities to conduct academic and industrial research work in the field of rapid prototyping digital-based systems, in general, and digital signal processing systems, in particular.

2.2 Current Participation in Competitive Research Grants

"Continuation of the TI Analog, Digital, and Mixed-signal Electronics Program at the UPRM"
Researchers: Rogelio Palomera (PI), Manuel Jiménez (Co-PI), Manuel Toledo Quiñones (Co-PI).
Sponsor: Texas Instruments

2.3 Strategic R&D Alliances with other Institutions

Texas Instruments, Inc.

2.4 Research Summaries

The Integer-Pair Representation: A Suitable Format for the Parallel Manipulation of Boolean Algebra—Prof. Manuel Jimenez

This work deals with the creation of a new format to represent binary terms in Boolean functions, called the Integer Pair Representation (IPR). This novel format uses an ordered pair of integers to compactly represent each cube of a Boolean function written as a sum-of-products in either canonical or non-canonical form. Properties of the representation have been formally established unveiling its advantages for developing algorithms enabling the concurrent processing of Boolean variables on SISD machines. In the current stage of development, these properties and algorithms have been combined to develop a prototype program for minimizing single-output binary valued Boolean functions.

Scalable Computing Methods for Signal Processing Systems—Prof. Domingo Rodriguez

This work deals with the analysis, design, and implementation of communications signals and circuits for signal processing systems. In particular, the work concentrates on developing scalable computing methods in signal processing for various stages of transmitter and receiver circuits and systems in digital radar systems, and digital communications systems in general. New hardware implementation strategies for signal synthesis, digital modulation, and channel coding techniques are being studied for signal transmission and reception efforts in multi-input multi-output (MIMO) adaptive sensor array radar systems. Special attention is being given to time-frequency representation techniques for the firmware implementation of surface point target response functions for synthetic aperture radar (SAR) processing operations in applications such as SAR multifrequency, repeat-pass interferometry, polarimetric interferometry, and moving target detection.

TCP/IP Offloading for Multi-Homed Servers—Prof. Isidoro Couvertier

This work is focused on TCP/IP (Transport Control Protocol/Internet Protocol) offloading based on frame carrier protocols, especially Ethernet. Studying Ethernet offloading as a frame carrier protocol is a feasible way to manage parallelism for multi-homed servers. The first stage of TCP/IP offloading begins with frame carrier offloading as a stepping-stone for higher offload layers of TCP/IP. The first stage of this project is based on frame carrier protocol. Overall concepts of computer networks, programming languages and compilers, operating systems, and application development will be used for the completion of this work. In addition, this work will address the subject of offloading onto an intelligent network card and the real time operating systems issues in relation to the TCP/IP offloading itself.

2.5 Publications

M. Jiménez, M. Shanblatt, "Integrating a Low-Power Objective into the Placement of Macro Block-based Layouts," Proceedings of the IEEE. Midwest Symposium on Circuits and Systems, pp. 62-65, Ohio, Aug. 2001.

M. Jiménez, **D. Rodriguez, N. Santiago**, "Scalable Floating Point FPGA Cores for Digital Signal Processing," Proceedings of the Annual Automatics, Instrumentation and Industrial Electronics Conference (SAAEI 2001), CUBA, September 2001.

M. Jiménez, **M. Shanblatt**, "A Low-power Approach to the Placement of Macro Block-based VLSI Layouts," Proceedings of the Annual Automatics, Instrumentation and Industrial Electronics Conference (SAAEI 2001), CUBA, September 2001.

M. Jiménez, R. Palomera, and M. Toledo, "Undergraduate Research and Co-op Education: A Winning Combination", To appear in Frontiers In Education, FIE-2002, Boston, MA, Nov. 2002

J. Navarro, J. Borges, and **M. Jiménez**, "Electronic Academic Counseling System", To appear in Frontiers In Education, FIE-2002, Boston, MA, Nov. 2002

D. Rodríguez, "A Computational Kronecker-core Array Algebra SAR Raw Data Generation Modeling System," IEEE 35th Asilomar Conference on Signals, Systems, and Computers, Nov. 2001, Monterrey, California.

D. Rodríguez, "Signal Algebra Operators for SAR PSF Hardware Computations," 2002 AIRSAR Earth Science and Applications Workshop, NASA Jet Propulsion Laboratory, Pasadena, California, March 2002.

D. Rodríguez, D. Rueda, H. Nava, A. Quinchanegua, "High Performance SAR Raw Data Generation Algorithms for Remote-sensed Imaging Applications," IEEE IGARSS 2002, Toronto, Canada, July 2002.

D. Rodríguez, A. Quinchanegua H. Nava, "Signal Operator Cores for SAR Real Time Processing Hardware," IEEE IGARSS 2002, Toronto, Canada, July 2002.

3.0 Intelligent Systems and Image Processing Group

Jorge Ortiz, jortiz@ece.uprm.edu, ***Coordinator***
Hamed Parsiani, parsiani@ece.uprm.edu
Ramón Vásquez, reve@ece.uprm.edu

3.1 Description

This group is aimed to develop intelligent systems applications in engineering and computer sciences. Also, the group is dedicated to image compression, automatic object recognition, and image enhancement.

3.2 Current Participation in Competitive Research Grants

Soil Moisture Content Extraction, Using Images from Ground Penetrating Radar—NOAA

3.3 Strategic R&D Alliances with other Institutions

This research group is collaborating with the City College of the City University of New York. Prof. R. Vásquez and Prof. H. Parsiani are working with partners at this institution in remote sensing applications.

3.4 Research Summaries:

3.4.1 Image Recognition with the aid of Multisensor Data Fusion—Prof. Hamed Parsiani

Remotely sensed data has increasingly been used to improve such applications as weather forecasting, earth resource survey, and transportation management. Such applications benefit by data fusion techniques that capture the unique attributes existent in a multisensor system. The remotely sensed data obtained from satellites and high altitude planes, and other sensors such as magnetic, seismic, or conductivity sensors can successfully be a part of a sensor data fusion architecture. The fusion architectures so far depend on the particular application, sensor resolution, and the available processing resources. To perform band rationing, and extract features, the general methods available include: parametric techniques (e.g.. Bayes, Max-Likelihood), non-parametric methods (e.g.. linear, polynomial), Nearest Neighbor approach, Neural Network, Fuzzy Logic, and Fractals. The methods available for making decisions include: Degree of Consensus, Boolean Logic Based strategies, and Approximate Reasoning (Fuzzy Logic, Evidential Reasoning). These methods will set the stage for other application specific methods to be developed in our research. The work in progress uses both Fuzzy C-Means, and Neural Network Classification methods to identify the real objects in an image and consequently classify them accurately. The images used for classification are generated by Ground Penetrating Radar. Images of the same area, but obtained by other sensors will individually be processed and automatically compared to reach an appropriate consensus as to the objects being recognized in the image.

3.4.2 Intelligent Parser and Voice Recognition Systems—Prof. Jorge Ortiz

The conversion from spoken language to text can generate mistakes due to several environmental and human conditions that “confuse” conversion algorithms resulting in a wrong text output. The fuzzy syntactic parser presented in this paper helps detect and correct these errors in the text output. Humans are able to understand commands under adverse conditions due to their experience, common sense, and other cognitive abilities. Fuzzy algorithms may emulate the human ability to correct and understand words incorrectly converted to text by *ASR* systems. For example, humans are able to understand homophone words based on the context of the sentence. Webster's dictionary defines a homophone as “a word having the same sound as another, but differing from it in meaning and usually in spelling: as, all and owl; bare and bear; rite, write, right, and Wright. ” Homophones like the words “to” and “two” may be correctly converted as in the statement “I have to play” or “I have two play.” A regular parser could parse the first statement but not the second, due to the word “two” that cannot be recognized as a syntactically correct word. A fuzzy parser is presented in this paper that resembles the human ability to recognize homophone words. The fuzzy parser can help detect other problems in the conversion from spoken language to text such as noise like “ups” or “ahh”, and words spoken under stress such as “twooo” instead of “two.”

3.3.3 Logical Operators for Texture Analysis—Prof. Rámon Vásquez

Texture classification is an image processing technique by which different regions of an image are identified based on texture properties. This process plays an important role in many industrial, biomedical and remote sensing applications. Early work utilized statistical and structural methods for texture feature extraction. Gaussian Markov random field (GMRF) and Gibbs distribution texture models were developed and used for texture recognition. Power spectral methods using the Fourier spectrum have also been used. DCT, Walsh-Hadamard and DHT have been used for recognition of two-dimensional binary patterns. One of the major developments recently in texture segmentation has been the use of multiresolution and multichannel descriptions of the texture images. Logical operators have been used for Boolean analysis, minimization, spectral layered network decomposition, spectral translation synthesis, image coding, cryptography and communication.

3.5 Publications

J.L. Ortiz 2001. Fuzzy Syntactic Parser for Command Language Recognition Under Adverse Conditions. I/ITSEC (Intersrnterservide/Industry Training, Simulation and Education Conference), Orlando Florida, November 2001.

V. Manian and R. Vásquez, A genetic algorithm for texture description and classification, Proceedings of AeroSense'02, April 2002.

V. Manian and R. Vásquez, Approaches to color and texture based image classification, Journal of Optical Engineering, SPIE, accepted 2002.

4.0 Parallel and Distributed Computing Research Group

Wilson Rivera, wrivera@ece.uprm.edu, ***Coordinator***
Dorothy Bollman, bollman@cs.uprm.edu
Jaime Seguel, Jaime.Seguel@ece.uprm.edu

4.1 Description

The Parallel and Distributed Computing Group performs research in the design, implementation, and efficiency measurements of parallel algorithms. It also addresses research issues related to parallel and distributed computing systems with an emphasis in high-performance cluster computing. http://www.ece.uprm.edu/PDC

4.1 Current Participation in Competitive Research Grants

TBD

4.2 Strategic R&D Alliances with other Institutions

TBD

4.3 Individual Research Summaries

4.3.1 High Order Parallelization and Coupling of Simulation Codes - Prof. Wilson Rivera

One of the challenges in scientific computing is creating a flexible and open development environment for numerical simulations in parallel environments. From the implementation point of view, modern programming languages offer powerful tools for flexibility, such as the inheritance of object-oriented programming. The numerical approach however should be flexible as well. Consequently, flexible domain decomposition techniques need to be implemented without compromising the accuracy of the algorithms as well as efficient management strategies to deal with all the components. The general aim of this research is to address the problem associated to the software design of Computational Fluid Dynamics (CFD) solvers on parallel computers.

We proposed a high-level parallelization of CFD codes through an extensive use of object-oriented programming techniques. A modular implementation of mathematical abstractions, which is a direct advantage of object-oriented programming, allows for the generalization of computational kernels, which are reusable in many simulation applications from different scientific computing disciplines. This approach makes it possible to hide computational details when it is needed as well as produce simulators with unified generic interfaces. We argue that the combination of flexible domain decomposition methods with extensive use of object-oriented techniques will result in an efficient, flexible, and systematic process for developing parallel codes to solve CFD Problems.

4.3.2 Special Purpose Fast Fourier Transform (FFT) Algorithm - Prof. Jaime Seguel

The FFT is crucial to scientific computation. In several of these instances, the data to be transformed possesses special features such as symmetries, irregular shapes, or, as in physics, some degree of accuracy is demanded. The proposed research is intended to design and test algorithms for applications such as Volterra filters, Poisson solvers, and Crystallographic FFTs. This work concentrates on the use of mathematical properties for improving the computation of multidimensional FFTs of data sets endowed with special features such as symmetries or irregular shape, and improving the precision of FFT computations. The work contemplates implementations on parallel computing environments as well as the design of special purpose compilers for the efficient production of performance critical code segments.

4.3.3 Improving the Efficiency of Backtracking Algorithms - Prof. Dorothy Bollman

Many fundamental problems of computer science and operations research that involve a search for a set of solutions or which require an optimal solution satisfying certain constraints can be solved by "*backtracking*" methods. Unfortunately, backtracking is not efficient, generally requiring exponential execution time. For such an algorithm, there is necessarily an upper bound to problem size beyond which reasonable solution times are unattainable. Nevertheless, improvements in the algorithm can considerably improve this upper limit. This work is directed toward that goal.

This work will contribute to the knowledge of backtracking, one of the most fundamental techniques in algorithm design. It has already yielded a new, faster algorithm for the classical *n-queens* problem. In the long term, it can provide new Costas sonar arrays, which are useful in encoding radar and sonar signals.

4.4 Publications

D. Bollman, and E. Orozco, "A Faster Algorithm for the n-Queens Problem," To appear in Congressus Numerantium 2001.

D. Bollman, J. Seguel, J. Feo - "A functional Approach to Radix-r FFTs". Progress in Computer Research, Vol. I, Ed. F. Columbus, Nova Science Publishers, 2001, pp 77-103.

W. Rivera, J. Zhu, and D. Huddleston, "An efficient parallel algorithm with application to computational fluid dynamics," Journal of Computers & Mathematics with Applications, Accepted January 16, 2001.

W. Rivera, J. Zhu, and D. Huddleston, "An efficient parallel algorithm for solving unsteady Euler equations," Parallel Computational Fluid Dynamics: Recent Development and Advances, Elsevier Science. Accepted May 18, 2001.

W. Rivera, "Stability analysis of numerical boundary conditions in domain decomposition algorithms," Journal of Applied Mathematics and Computation, Accepted December 2001.

W. Rivera, "Numerical interface conditions for non-overlapping domain decomposition algorithms," Journal of Parallel and Distributed Computing. Submitted December 2001.

W. Rivera, J. Zhu, and D. Huddleston, "Parallel performance investigation of a domain decomposition algorithm," Proceedings of the Tenth SIAM Conference on Parallel Processing for Scientific Computing. Portsmouth, Virginia, 2001. (SIAM ISBN 0-89871-492-3)

W. Rivera, J. Zhu, and D. Huddleston, "An efficient parallel algorithm for solving unsteady nonlinear equations", Proceedings of the International Conference on Parallel Processing Workshops, Valencia, Spain, 2001, IEEE Computer Society, pp 79-84.

W. Rivera, "Adaptivity Support For Computational Grid-Aware Clusters," 6th World Multiconference on Systemics, Cybernetics and Informatics (SCI2002) to be held in Orlando, in July 14-18, 2002.

J.Seguel, D. Bollman, E. Orozco - New Prime Edge-Length Crystallographic FFT. To appear in Lecture Notes of Computer Sciences, ELSEVIER.

J. Seguel - A Unified Treatment of Symmetric FFT Code Generation. Conditionally accepted for publication in IEEE Transactions on Signal Processing.

5.0 Software Sciences and Engineering Group

Néstor Rodríguez, nestor@ece.uprm.edu, ***Coordinator***
Javier A. Arroyo, jarroyo@ece.uprm.edu
José Borges, borges@ece.uprm.edu

5.1 Description

The objective of this group is to develop research in software fields that could result in novel software applications for our society. The group is integrated by researchers with expertise in areas such as human-computer interaction, software engineering, databases and programming languages. The multidisciplinary nature of the projects proposed by this group require the integration of professionals and researchers from other fields such as medicine, nursing and total quality management.

5.2 Current Participation in Competitive Research Grants

ERF (Event Rule Framework) - Sponsored by NSF (PI: Javier Arroyo, CoPIs: José Borges and Nestor J. Rodriguez)

O2S2 Sponsored by IBM (B. Velez and J. Arroyo (Co-PI)

5.3 Strategic R&D Alliances with other Institutions:

Clinical Computing Center, School of Medicine, Harvard University.
Consultant: Daniel Sands

5.4 Research Summaries

5.4.1 Development of a User Interface for an Inpatient Computer-Based Patient Record—Prof. Nestor J. Rodriguez & Prof. Jose Borges

During this year the user interface of a prototype of the electronic patient record system was developed. During the summer professor Nestor J. Rodriguez and graduate student Viviam Murillo traveled to Boston to conduct a user interaction study. The study was conducted at the Center for Clinical Computing of the Harvard Medical School with the collaboration of our project consult Dr. Daniel Z. Sands. The study compared physician interaction with electronic patient record systems with text-based and graphical-based user interfaces. Nineteen internal medicine physicians of the Beth Israel Deaconess Medical Center participated in the study. The results of the study revealed that a graphical-based interface can significantly reduce the time it takes physicians to complete typical tasks in comparison with a text-based interface. The results of the study also revealed that physicians can get more satisfaction from interacting with a graphical-based electronic patient record system than with a text-based system. This study is describe in more detail in the paper titled: *A Study of Physicians Interaction with Text-Based and Graphical-Based Electronic Patient Record Systems*, which has been accepted for publication in the Proceedings of the 15th. IEEE International Symposium on Computer-Based Medical Systems, June, 2002.

A second study was conducted at the University Hospital in San Juan Puerto Rico with the collaboration of Dr. Tricia B. Perez. The study compared physician interaction with a traditional paper-based patient record system and our graphical-based electronic patient record system. Seventeen internal medicine physicians participated in the study. The results of the study did not reveal a significant difference in the overall time to complete typical physician tasks. However, on average physicians can perform viewing tasks faster, documenting tasks slower and ordering tasks at about the same speed on the graphical-based system than on the paper based system. Physicians were found to be significantly more satisfied with the graphical-based system than with the paper-based system. The results also revealed that physicians with higher levels of computer literacy and typing skills can complete typical tasks in significantly less time on a graphical-based system than physicians with lower levels of computer literacy and typing skills. This study is described in more detail in the paper titled:

A Usability Study of Physicians Interaction with a Paper-Based Patient Record System and a Graphical-Based Electronic Patient Record System, which has been submitted to the American Medical Informatics Association Conference 2002.

We are in the process of writing a more extensive paper describing the above mentioned studies. We plan to submit this paper to the Journal of the American Medical Informatics Association.

The results of the above mentioned studies have also provided us valuable information to refine the graphical user interface of our prototype. We are currently working on that and plan to complete the fine tuning before the beginning of the summer. During the summer we plan to conduct additional user tests with the prototype.

During this semester we started a research focused on physicians and nurses interaction with handheld electronic devises. We are interested in studying the usability issues that must be considered in the development of applications for accessing electronic patient record system with hand held devices. We are planning to conduct a task analysis with physicians and nurses of the University Hospital. This analysis will help us develop applications for accessing the patients' records and eventually conduct usability studies. We plan to conduct these studies during the summer at the University Hospital in San Juan and at the Beth Israel Deaconess Medical Center in Boston.

We also have work in progress to provide support for nurses to develop care plans, perform daily assessment of patients and enter notes. Graduate student Leo Velez is working on the development of the user interfaces. This work will be integrated to our electronic patient record system. We plan to conduct user testing with these applications during the summer.

We have a great deal of interest on transferring the technologies developed through our research to hospitals in Puerto Rico. To accomplish this we will be conducting an assessment of the state of the art of the electronic support for patient record systems in hospital in Puerto Rico. We also plan to establish a very close collaboration with a hospital that allow us to implement our technology on a real hospital setting and conduct further usability studies.

5.3.2 Design and Implementation of a Ruled-Based Intelligent Event Service (RUBIES) - Prof. Javier Arroyo

Although a number of standards for supporting heterogeneous distributed systems (HDS) already exist (e.g., RPC, CORBA, DCE, DCOM, Java RMI), there is still a lack of abstractions, services and tools for specifying, designing, implementing, monitoring, debugging and maintaining a HDS. For an effective support of these activities, a *conceptual view* of a distributed system is needed. We mean by conceptual view the specification of the system as seen by the community of developers, in terms of structure and behavior. It should be noted that existing environments (or "middleware") do well in specifying structure, i.e., attributes and structural relationships among system components. However, in terms of behavior, the specification is limited to the definition of function- or method- signatures. The *semantics* of behavior are hidden or "buried" inside the application code (implementation). Therefore, anyone interested in knowing the behavioral semantics of the system either has to look into the application code, or into a specification or design document (which probably will be "out of sync" from the implementation). Furthermore, existing environments do not allow incorporating changes in behavior dynamically; any change in the behavior will involve changes in the implementation of functions or methods, which in many cases requires recompilation.

This work is about the design and implementation of a Rule-Based Intelligent Event Service (RUBIES), which will provide services that will allow the definition of the semantics of HDSs in a high-level manner. RUBIES will have the following characteristics:

- **Object-oriented model.** Similar to CORBA, DCOM and Java RMI, RUBIES should have an object-oriented model in which system components are treated as objects.

- **Events.** RUBIES will use events as an abstraction for specifying system behavior. The specification of behavior is done in terms of events that trigger rules. A formal object-oriented event model will allow the systematic definition of events.
- **Rules**. In RUBIES, ECAA (Event-Condition-Action-Alternative Action) rules are used to specify system behavior. Rules are defined in terms of trigger events, conditions that need to be satisfied to apply the rule, and a set of actions and alternative actions to perform when the events occur and the conditions are satisfied. A formal object-oriented rule model will allow the design and implementation of a rule support system independent of any particular rule language syntax.
- **Rule-based event handling.** Instead of being buried inside application code, event handling is performed by means of rules. ECAA rules (Events-Condition-Action-Alternative Action) are defined in terms of event filtering specification (triggering events, priority, conditions), actions and alternative actions.
- **Rule scheduling.** Rules can be scheduled to be active or inactive at different points in time. RUBIES will provide the functions for allowing scheduling of rules.
- **Immediate and delayed event handling.** Both immediate and delayed event handling is supported by keeping events in an event queue during a specific period of time ("time-to-live") defined for each event. Delayed processing is carried out by inactive rules that, upon activation, are processed against events waiting in the queue.
- **Distributable and replicatable architecture.** The architecture of RUBIES allows for the distribution of load among different instances of the service (for performance). Similarly, many replicated instances of RUBIES may co-exist in a HDS (for fault tolerance).

5.3.2 Usability of E-commerce Sites - Prof. Nestor J. Rodriguez & Prof. Jose Borges

During this year a preliminary characterization of e-commerce site was accomplished. Twenty sites were analyzed. The sites were characterized in terms of the page layout, the services provided and the tools available to the clients.

Currently we are conducting a usability test to study user interaction with ten e-commerce sites. The participants are asked to performed typical tasks needed to select and purchase items on the site. The interaction is video recorded for further analysis. The participants are asked to use the think aloud method in other to understand the rational for the navigation strategy followed and the selection of links and tools. The data recorded from this study will be analyzed and a paper will be written to disseminate the results.

5.4 Publications

N, Rodriguez,. Murillo, J., Borges,V., J.A., Sands, D.Z., and Ortiz, J. A study of physicians' interaction with text-based and graphical-based electronic patient record systems. Proceedings of the 15th. IEEE International Symposium on Computer-Based Medical Systems, June, 2002.

6.0 Advanced Data Management Group

Manuel Rodriguez -Martinez, manuelr@acm.org, Coordinator
Bienvenido Vélez,bvelez@acm.org
Pedro I. Rivera Vega – pedro.rivera@ece.uprm.edu

6.1 Description

Our research will focus on the design and implementation of next generation database and information retrieval systems with emphasis on Web information systems, handheld devices, reliability and fault tolerance, multimedia databases and cluster computing.

Vision

- Establish a premier Research and Development Center dedicated to the advancement of Information Management Technologies, including: Database Management, Information Discovery, Network Middleware, and Database-Enabled Web Applications.

Mission

- The ADM Group is committed to conduct both theoretical and practical research aimed at the discovery of new theories and the development of new systems with particular emphasis on technologies with the potential for deep impact on the improvement of the quality of life in our society.

- The ADM group is committed to the advancement of Data Management technologies. Specific areas of emphasis include: Database Management, Information Retrieval and Discovery, Fault-tolerant Systems, Integrating Systems, Interoperability, and reliable Information Storage and Dissemination.

- The ADM group is committed to the integration of research and education through the rapid transfer of discoveries to the classroom. The group will be one of the main driving forces behind the development of the curriculum pertaining to Data Management at the University of Puerto Rico.

The ADM group is currently working on the following projects:

- Data Service Composition in Peer-to-Peer Architectures (P2P)
- Verizon Intelligent Home (*i*Home)
- Dynamic Image Retrieval and Composition Services in Distributed Information Systems
- Adaptively Replicated Information Services (ARIS)
- Fault-tolerant Mass Transit Passenger Information Systems (TU-PIS)
- Inforadar: Document Classification using Query Lookahead
- Open Source Operating Systems (collaboration with IBM)

6.2 Current Participation in Competitive Research Grants

O2S2 Sponsored by IBM (B. Velez and J. Arroyo (Co-PI)

6.3 Strategic R&D Alliances with other Academic and Industrial Institutions

1. IBM – Open Source Operating Systems Project
2. Tren Urbano - Passenger Information System
3. CenSSIS Engineering Research Center - Dynamic Image Retrieval and Composition Services in Distributed Information Systems

6.4 Research Summaries

6.4.1 Interactive Queries Hierarchies for Effective Information Discovery at UPR-Mayagüez - Prof. Bienvenido Vélez

Advances in processor technologies suggest that future search engines will be capable of spending orders of magnitude more processing capacity per user request without inducing noticeably larger response times. A new information discovery technique called *query lookahead* invests additional computation on the eager evaluation of multiple queries automatically generated from an initial user query.

Query lookahead has the potential of improving search systems in at least two novel ways. First, it enables the deployment of anticipatory user interfaces capable of presenting the result sets of automatically generated refined queries ahead of time. Refined queries serve as categories upon which a large and imprecise result set can be organized. Second, query lookahead has the potential of improving the effectiveness of feature (e.g. term) selection algorithms. These algorithms can be improved by exploiting information about the result set induced by each potential feature when combined with the user query. This research focus on a new network search system, InfoRadar, exploiting query lookahead along these two lines. In response to a user query, InfoRadar displays a hierarchically organized selection of refined queries that we call an interactive query hierarchy. We have developed InfoRadar as a vehicle for testing our hypothesis that interactive query hierarchies can improve information discovery effectiveness. InfoRadar has three main software components: a multi-threaded Java applet, a server module and an indexing module. InfoRadar supports boolean queries using a syntax borrowed from the popular Altavista (www.altavista.com) search engine. In response to a query request from the applet, the InfoRadar server returns a hierarchy of queries together with their individual result set.

6.4.2 Data Composition Services in Peer-to-Peer Architecture - Manuel Rodríguez Martínez

Next-generation Distributed Information Systems will consist of hundreds of thousands, perhaps millions, of diverse data sources located on geographically distributed networks like the Internet. In these types of large-scale distributed environments, heterogeneity in terms of hardware devices, software components, network connectivity and system configuration will be a fundamental characteristic of the data sources. In fact, these data sources might reside on high-end servers, desktop computers, mobile laptop computers, hand-held devices, intelligent sensors and appliances, or embedded computer systems.

Data integration and interoperation between these data sources will be a critical requirement to harvest the vast amounts of valuable information stored and maintained by the data sources. Information could be extracted from any available data source, whether it is a satellite image from an Earth Science database, or a phone book list, encoded in XML, that is extracted from a Palm-Pilot. Therefore, a data source site cannot be defined based on the size of stored data sets, or on the software environment being run, but rather, on whether other sites in the system retrieve the information held by the data source. In the other words, a data source is any site that provides a service to access some kind of data. Clearly, the distinction between what constitutes a client site and what constitutes a server site will be blurred, since any site can act as a client or as a service provider to another site in the system. Moreover, the sheer number and diversity of data sources implies that there cannot be a single authority that effectively coordinates and controls the access to data, or to the computational services in the system. These observations motivate us to conduct research and point us in the direction of a peer-to-peer dynamic environment [6,26] in which any site can request or serve data, and must engage in a cooperative effort aimed at satisfying the requests for data and services associated with the queries posed by interested end-users.

We envision a decentralized Peer-to-Peer software framework in which user-defined code and control is released to the local executing sites (client or data sources), which will decide which are the sites that will supply data, computational services, and the aggregation of results. The receiving site may partially execute its code on its local environment, and pass it along with partial results to next peer site, or coalition of peer sites that will continue with the computational process. This framework is based on a model for composition of data services, where one site performs a given task and ships its results, plus some control information, to another site that will continue with the computational process.

6.5 Publications

Bienvenido Vélez and Jairo E. Valiente. "Interactive Query Hierarchy Generation Algorithms for Search Result Visualization". In Proceedings of Internet and Multimedia Systems and Applications (IMSA 2001). Honolulu, August 2001.

Bienvenido Vélez and Juan A. Torres. "Anticipatory User Interfaces for Search Result Visualization using Query Lookahead". In Proceedings of Americas Conference on Information Systems (AMCIS 2001). Best Paper Award. Boston, August 2001.

Manuel Rodriguez-Martinez, Nick Roussopoulos, "MOCHA: A Self-Extensible Database Middleware System for Distributed Data Sources", In *Proceeding of the ACM SIGMOD International Conference on Management of Data*, Dallas, Texas, May 2000.

Manuel Rodriguez-Martinez, Nick Roussopoulos, "Automatic Deployment of Application-Specific Metadata and Code in MOCHA", In *Proceedings of the 7th Conference on Extending Database Technology* (EDBT 2000), Konstanz, Germany, March 200.

Manuel Rodriguez-Martinez, Nick Roussopoulos, "MOCHA: A Database Middleware System Featuring Automatic Deployment of Application-Specific Functionality", Demo Description, In *Proceeding of the ACM SIGMOD International Conference on Management of Data*, Dallas, Texas, May 2000

Part C: Other Collaborators in the PRECISE Project

This section describes the research activities of associate research collaborators who are indirectly participating in the PRECISE Project though various degree of students, travel, and hardware/software support provided by the project. All the graduate students appearing in this section are currently fully supported by the PRECISE Project.

1.0 Robert Acar - acar@cs.uprm.edu

1.1 Student Name: Armando Yance
1.2 Research Tittle: Optical Stellar Imaging Interferometer
1.3 Research Description

Optical stellar interferometers are used to make measurements of the fine angular detail in the visible and near infrared emission from celestial sources. The angular resolution of single optical telescopes (at best this is of order 1 second of arc, given the effects of atmospheric turbulence) is insufficient for a number of astronomical objectives. Despite the advent of adaptive optics, which is able to correct to a large extent the aberrations caused by the atmosphere, even the largest of today's telescope are only 10 metres in diameter. To be able to see detail as yet inaccessible to us, on the order of a millisecond of arc, we require telescope baseline diameters at least an order of magnitude larger.

The principal motivation to build a stellar interferometer is that such instruments provide access to high angular resolution information. This comes at a small fraction of the price of a single-aperture telescope with similar angular resolution, even if such single-aperture items were feasible.

In order for this interferometer to produce interference fringes (the signal) the system must be correctly aligned such that the optical path lengths of its arms are equalized. The optical path is defined to be the refractive index of the medium (usually air) multiplied by the physical path length traversed by the light beam through an optical instrument. In addition to this, the polarization vectors of the light beams coming from each telescope must be the same.

Many of the instrumentalization subsystems will be controlled in real-time, while others have to be adjustable from a remote station so as not to introduce extra turbulence into the beam-combining plane.

2.0 Mark Chang— mark@feyman.upr.clu.edu

2.1 Research Title: Adaptive Optics and Interferometer
2.2 Research Description

The particular focus of this project is on the development of Adaptive Optics systems, for the purpose of the real time correction of atmospherically induced turbulence, and the application of this technique in conjunction with interferometry to produce large aperture, high throughput inteferometric imaging systems. The primary goal of this is to pave the way for the construction of a next generation optical interferometer array (the Magdalena Ridge Observatory) to be built in New Mexico by a consortium, including UPR. A side effect of this work has been to generate new devices for optical wavefront sensing, with novel algorithms for the wavefront reconstruction. The wavefront sensors are being studied in relation to industrial and medical applications as well as astronomical imaging. Also, a novel theoretical formulation for a wavefront correction device has been devised.

Interferometric imaging is being investigated in the form of the construction and implementation of a multi-telescope interfermeter locally. This includes not just the hardware, but more importantly, the real time software control systems and the image capture / signal processing subsystems.

3.0 Miguel Vélez— mvelez@ece.uprm.edu

3.1 Student Name: Alejandra Umaña
3.2 Research Title: Determining the Dimensionality of Hyperspectral Images
3.3 Research Description

Hyperspectral remote sensing is an important technology for the monitoring of the environment. The Hyperspectral concept is illustrated in Figure. 1. For each wavelength, we have an image of the region and for each pixel we have a sample of the electromagnetic spectra of the object contained in the field of view of the sensor. The high spectral resolution of Hyperspectral imagery (HSI) gives us the capability to distinguish and identify spectrally unique materials on the observed area. With HSI, we can identify spectral patterns that are not apparent in low spectral resolution multispectral images. Some examples of existing Hyperspectral imaging sensors are: the Airborne Visible / Imaging Spectrometer (AVIRIS) with 224 channels at 10nm, the Compact Airborne Spectrographic Imager (CASI) with 288 channels at 1.8nm and the Hyperspectral Digital Imagery Collection Experiment (HYDICE) with 210 channels at 10nm respectively.

High storage and transmission requirements, computational complexity, and statistical modeling problems with HSI motivate the idea of dimension reduction. A key problem in dimensionality reduction in HSI is determining the inherent dimension of the data set. A typical HSI might cover a scene of 1000 by 1000 pixels so that at a given frequency a single band can be represented by a vector in $R^{1,000,000}$ however the whole image has at most 224 bands as in AVIRIS so the entire image is embedded in a 224 dimensional subspace at most. Further exploration of the high correlation between bands results in the data typically having an inherent dimension in the order of 10-20 as reported in the literature.

The objective of this project is to implement an automatic method to determine the dimension (in a linear algebra sense) of the subspace that encapsulates "most" of the HSI. We will say "most", because of noise the strict dimension will be 224 (for an AVIRIS image)

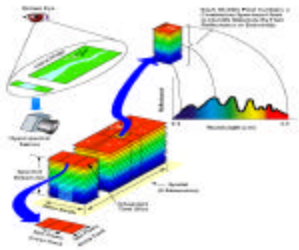


Fig. 1 Hyperspectral Image Concept

4.0 Sandra Cruz Pol— pol@ece.uprm.edu

4.1 Student Name: Jorge M. Villa Giron
4.2 Research Title: Estimating Ice Crystal Size in Cirrus Clouds using 33 and 95 GHz Radar
4.3 Research Description

This work consists of two stages. First, the simulation of the radar scanning effect on the minimum detectable signal (equivalent radar reflectivity in decibels, dBZe) at 33 GHz and 95 GHz and a comparison with actual radar data measured at Australia during spring of 1995. This can be done with the help of radiosonde data with which the atmospheric attenuation will be modeled. The second stage consists of the design an algorithm to estimate the backscattering from ice crystals found in cirrus clouds known as bullet rosettes. This includes the development of a model for the ice particles' shape, taken from actual field airborne experiments, and the design of a toolbox for DDSCAT to model the radar backscatter and reflectivity for these ice crystals. This will eventually help to estimate the size of ice particles in cirrus clouds by comparing this simulation to real data collected with UMass Cloud Profiling Radar.

5.0 Luis O. Jimenez—jimenez@ece.uprm.edu

5.1 Student name: Fernando Gallo Placencia
5.2 Research Title: Unsupervised Fuzzy Contextual Classification for Hyper Spectral Data
5.3 Research Description

Spatial resolution has been used in union of spectral information in supervised classification but it has not been exploited in unsupervised classification. Unsupervised classification algorithms are techniques to extract information from Remote Sensing imagery based on machine calculation without prior knowledge of labeled samples. Most of current unsupervised algorithms only use the spectral response as information. The main advantage of unsupervised over supervised classification is that it does not require a high level of expertise from the analyst. Some mechanisms that could be used for integration spectral and spatial information are very time consuming such as the methods based on Markov Random Fields.

The motivation for examining integration of spatial and spectral information techniques is twofold. First, to gain an understanding of the approaches to the interpretation of remotely sensed data for land cover classification. Second, examine how data from diverse sources may be integrated during interpretation with a particular emphasis on a method that is able to combine spectral classification technique and spatial information by using fuzzy logic.

6.0 Gürsel Süer—a_suer@rumac.uprm.edu

6.1 Student Name: Alejandro Mosquera
6.2 Research Title: A Hierarchical Hybrid Approach to Cell Loading, Manpower Allocation and Job Sequencing in Cellular Manufacturing
6.3 Research Description

Labor-intensive manufacturing cells are characterized by the presence of light-weight, small inexpensive machines and equipment where continuous operator attendance and involvement are required. As a result, operator assignment to cells directly affects the output that can be obtained from a cell. Operator assignment to cells is affected by a number of factors. Minimum operators assignment is limited by the number of operations while maximum operator assignment is limited to the available space, span of control, operator skill levels, availability of machines or a combination of these factors.

In labor-intensive manufacturing cells, multiple manning for some operations becomes necessary when the number of operators assigned is greater than the number of operations, that is, some operations will be performed on multiple identical machines by using multiple manning. The first part of this problem focuses on two tasks in such environment:

1. Operator Assignment to cells
2. Cell Loading

Once these tasks are resolving, that is, when the ***minimum number of operators*** is obtained; a manufacturing scheduling problem is considered. The scheduling problems are classified into several groups based on the shop configuration, solution techniques, certainty of data, and arrival of jobs to the system. Because of the information about the jobs is available with certainty, this problem is called deterministic, and is focuses on cell scheduling with nonzero ready times (dynamic). When there are nonzero ready times, there are two cases to be considered; preemption allowed and preemption not allowed. This last part of the study focuses on “preemption-not-allowed” case with the objective of minimizing the average flow time.

7.0 José Colom— colom@ece.uprm.edu
Rafael Rodríguez— rafaelr@ece.uprm.edu

7.1 Research Area: Computational Electromagnetic Group

This Computational Electromagnetic Group is dedicated to the analysis of applied electromagnetic problems using the computer as the main tool. The group is interested in the simulation of new microwave structures including micro strip passive structures and printed antennas. The group is also interested in simulating different kind of microwave tunable components fabricated with ferroelectrics materials. The simulations are performed using different numerical methods techniques for electromagnetic such as Method of Moments and Finite Difference Time Domain. In addition, the group is also developing computational models for different remote sensing applications, such as microwave absorption spectra near 22 GHz, and active remote sensing of clouds.

The facilities for the group are located at the Radiation Laboratory (S-120). The lab is equipped with state of the art equipment acquired with a NSF MRI grant. The most important instruments housed in the lab are: two vector network analyzers (13 and 50 GHz), one spectrum analyzer (50 GHz), a near field scanner and an anechoic chamber for antenna measurements (2-40 GHz), a milling machine for prototype fabrication, an HP J Class Workstation and one IBM RISC 6000 Workstation. The laboratory also has available different electromagnetic simulators such as Momentum, XFDTD, and HFSS.

Part D: Past Collaborators in the PRECISE Project

In this section we provide a brief description of the research conducted by past collaborators participating in the PRECISE project.

1.0 Prof. Pablo Tarazaga

Research was conducted to advance old and develop new results in the theory of distance matrices which have an impact on numerical methods. The chief application of these numerical methods is in computational molecular configuration.

2.0 Prof. Octavian Nicolio

Research was performed on the design and implementation of parallel solvers for partial differential equations. These solvers are intended for applications on crack detection problems.

4.0 Prof. Javier Echauz

The prediction of epileptic seizures remains a high risk research area with the potential to significantly improve the quality of life of millions of people suffering from the disorder around the world. This project conducted efforts to formulate algorithms which may consistently predict seizures sufficiently in advance of electrographic and clinical onsets to allow warning of patients, families, and hospital staff, based on real-time processing of intracranial EEGs. The engineering methods involve intelligent extraction of multichannel signal features, and synthesis of Wavelet Neural Network probability estimators that continuously predict seizure events for a logarithmic-like scale of time horizons. The fundamental engineering knowledge derived from this work can enable the development of implantable intelligent devices that selectively trigger warnings and electrical, pharmacologic, or other abortive therapies, thus significantly deterring seizures prior to clinical manifestation.

4.0 Prof. José Luis Cruz

Study of performance advantages of introducing guided-wave and free-space optical interconnects at various levels of the interconnection packaging hierarchy of massively parallel processing systems. In general, these studies have focused on the technological advantages of optical interconnects in terms of density, bandwidth, and power considerations. While these studies have provided detailed information on the technological advantages of optical interconnects on a link-per-link basis, leading to many proof of concept system prototypes, a broader understanding of their impact on particular computational models and application classes is still needed in order to motivate the incorporation of these technologies into practical products.

Part E: Outreach - DISSEMINATION ACTIVITIESS

Outreach is a vital and important area in PRECISE. It involves all dissemination strategies and tactics to communicate to all stakeholders the outcomes and success stories of our project and to foster the creation of partnerships. We present below the PRECISE outreach activities for this AY 2000/2001.

1.0 Disseminate PRECISE program results and the CISE curriculum

1.1 Dissemination of CISE curricular materials

1.1.1 Organization of Ph.D. CISE Program Welcome and Orientation 2001

- Date: September 20, 2001
- Place: Eugene Francis

1.1.2 Elaboration of CISE Doctoral Program Brochure

1.1.3 Elaboration of CISE Doctoral Program Poster

2.0 Development and maintenance of WEB Page

2.1 Elaboration and documentation of information and data to different sections and sub pages

Our home page: www.precise.ece.uprm.

3.0 Preparation of brochures and portfolio to disseminate PRECISE's model, objectives and outcomes

- Universidad Central de Venezuela
- Universidad Simón Bolívar – Venezuela
- Fundación Instituto de Ingeniería – Venezuela
- Universidad de Los Andes – Venezuela

4.0 Elaboration of the official PRECISE poster

4.1 Poster section participation

4.1.1 First Congress: Partnering for Innovation & Technology for Economic Development
Date: November 10-11, 2001
Place: Hewlett Packard Computer and Information Cluster, and Mayaguez Resort & Casino

5.0 Article published on February 2002 in El Diálogo UPR principal newspaper, and La Gaceta Colegial campus newsletter.

6.0 Elaboration of a newsletter (Feb., March, April, May, August, Sept., Oct.)

7.0 Computing Research Conference 2002

The CRC 2002 conference was celebrated on March 16 of this year. This year, nine papers were selected for oral presentation and 29 for poster presentation (see list below). All the papers were included in the proceeding of the conference and were presented by graduated and undergraduate students as a result of their research effort.. The papers as well as other information about the conference is available on the conference website at:

http://ece.uprm.edu/crc/crc2002

The keynote address was given by Dr. Jose L. Cruz, a distinguished professor of the Electrical and Computer Engineering Department at UPR-Mayaguez. His keynote address was titled "*High-Tech Entrepreneurship*".

The chairmen of the conference were Nestor J. Rodriguez and Domingo Rodriguez. The Organizing Committee was formed by Carmen V. Santiago, Waleska Campos and Nestor J. Rodriguez.

7.1 Oral Presentations

1. Gabor Approach to Color and Texture Based Image Classification - Vidya Manian
2. A Methodology for Designing Multidimensional Symmetric FFTs with Prime Edge Length - Edusmildo Orozco
3. A TCP/IP framework for TCP/IP Offloading Implementation - Juan Manuel Solá
4. Application of Fourier Descriptors and Neural Network to Shape Recognition - Leonid Tolstoy
5. Cross-Language Information Retrieval System for Search Result Visualization using Query Lookahead - Jairo E. Valiente
6. Statistical Modeling of Clutter in Hyperspectral Data using 3D Markov Random Fields - Yahya Masalmah
7. A Hierarchical Hybrid Approach to Cell Loading, Manpower Allocation and Job Sequencing in Cellular Manufacturing - Alejandro Mosquera
8. Usability Study of a Physicians' User Interfaces for a Computer-Based Patient Record - Viviam L. Murillo
9. Unsupervised Fuzzy Contextual Classification for Hyper Spectral Data - Fernando Gallo

7.2 Poster Presentations:

1. A Survey of Software Optimization Techniques for Low-Power Consumption - Oscar Acevedo
2. Mpich Communication Protocols: Study of Their Behavior in a Hybrid System - Daniel Burbano
3. Development of Real Time Flood Alert System Using Object Oriented and Event Rule Programming Paradigms - Amarilis Cuaresma and Dianne López
4. Quantum Algorithm for N-Queens Problem – Héctor Del Manzano A. and Cesar Echevarria
5. Simulation of Water Column effect on Spectral Signatures in Shallow Waters – Julio M. Duarte
6. Behavioral Modeling of Dynamic Capacitive Loads on Sigma-Delta Modulators - Felix O. Fernandez
7. Imaging Multiple Planes Simultaneously with a Diffraction Grating - Carlos O. Font, Ivan Guzman, Orlando Marrero, Joel Vega, and Zugel P. Vidarte
8. Restoration of a Degraded Image - Elí Samuel García, and Ruth Rieckehoff
9. Artificial Vision for Vehicle Monitoring at Tren Urbano Stations - Jaime J. Laracuente
10. Back Propagating Neural Networks and the Coordination of Maximum Likelihood Equations to Create Logistic Splines - Elisa Maldonado
11. Image Compression Using Neural Networks - Yahya Masalmah
12. Scalable Parallel Saturating Multioperand Adders - Cristian Medina and Elianne Bravo
13. Hurricane Trajectory Prediction Using Artificial Neural Networks - Noel J. Mejías
14. RDL: A Rule Definition Language Specifying the Behavior of Distributed Systems - Edwin Moulier and Jaime Yeckle
15. Finite Discrete Cross-Ambiguity Function Processing and Earth's Surface Cell Resolutions - Hilaura R. Nava

16. Optimizing the Implementation of Floating Point Cores for FPGA Synthesis - Irvin Ortiz
17. Simplified JPEG Compression of Radar Sub-Surface Images and the Application of Threshold Filtering – Héctor J. Ortiz
18. On Implementations Issues of Parallel Computing Applications - Freddy Perez
19. Computing Methods for Signal Algebra Operators a DSP Core Implementations Approach - Alberto Quinchanegua
20. A BiCMOS Low Power, Low Voltage Current Mirror - Andrés Rosado
21. Implementation of the SVDSS in the ENVI / IDL Environment - Samuel Rosario
22. Inteferometric Imaging with an Aperture Masked Telescope - Freddie Santiago
23. Cache Effect Analysis of Different Types of Bit Reversal Algorithms - Jose E. Torres
24. Command Language Recognition Using Microsoft SDK-5 Speaker Identification Using Artificial Neural Networks - Teddy Torres
25. Determining the Dimensionality Hyperspectral Imagery - Alejandra Umaña
26. Definite Clause Grammars Intelligent Parser - Moraima Valle
27. Optimization of the Romberg's Method Using a Genetic Algorithm - Armando Vega
28. Performance of Scanning Millimeter-Wave Radar in a Tropical Environment - Jorge M. Villa
29. First steps toward Low Cost, Automated Stellar Interferometer - Armando Yance

8.0 Other Outreach Activities: Center for Hemispheric Cooperation in Research and Education in Engineering and Applied Science (CoHemis) Collaboration

8.1 Distribution and presentation of Ph.D CISE Program by Dr. Jorge I. Vélez-Arocho in Latin American dissemination CoHemis activities. The following universities were visited during this travel.

- Universidad Tecnológica Nacional— Argentina
- Universidad de Buenos Aires - Argentina
- Universidad Autónoma de Mexico
- Instituto Tecnológico de Monterrey—Mexico
- Universidad de Santiago de Chile
- Pontificia Universidad Católica de Chile
- Universidad Católica de Ecuador
- Escuela Politénica Nacional—Ecuador
- Secretaría Nacional de Ciencias y Tegnología de Ecuador
- Universidad Central de Ecuador
- Universidad Tecnológica de Panama
- Secretaría Nacional de Ciencias y Tecnología de Panama

9.0 Future Works

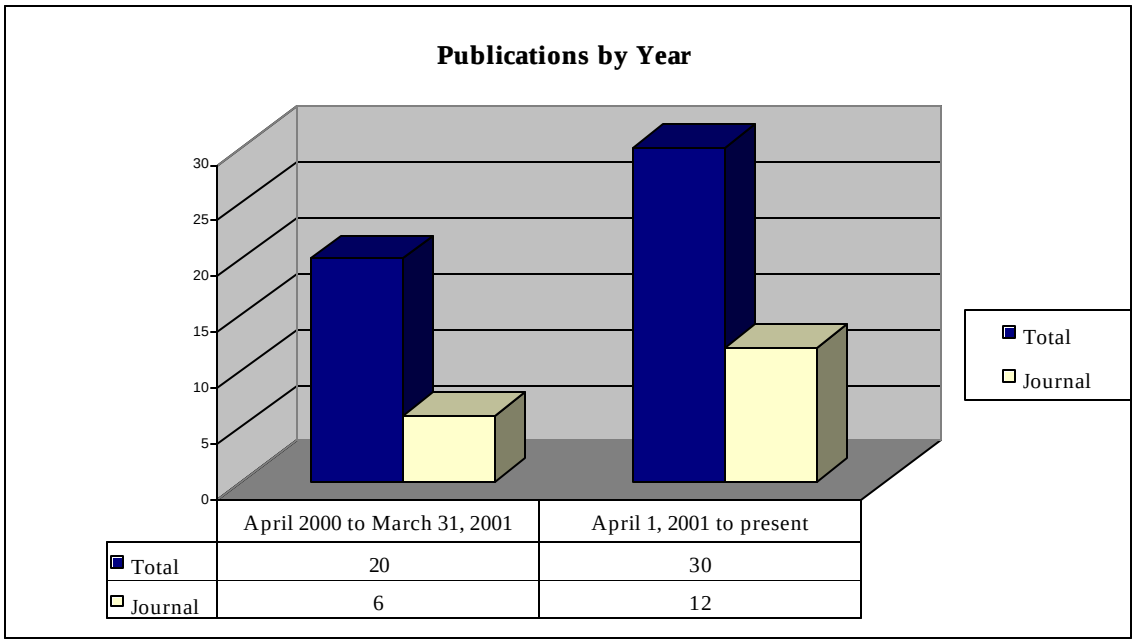
Outreach and dissemination strategies will be focused in the following activities:

- Development and elaboration of a formal video of PRECISE research facilities, laboratories, and activities—Summer 2002.
- Documentation of PRECISE development and performance as research and educational model in CD format —August to December 2002.
- Strengthen the relation with the academia, industry, and government through the research groups - Summer 2002 to May 2003.

Part G: Assessment - ACTIVITIES

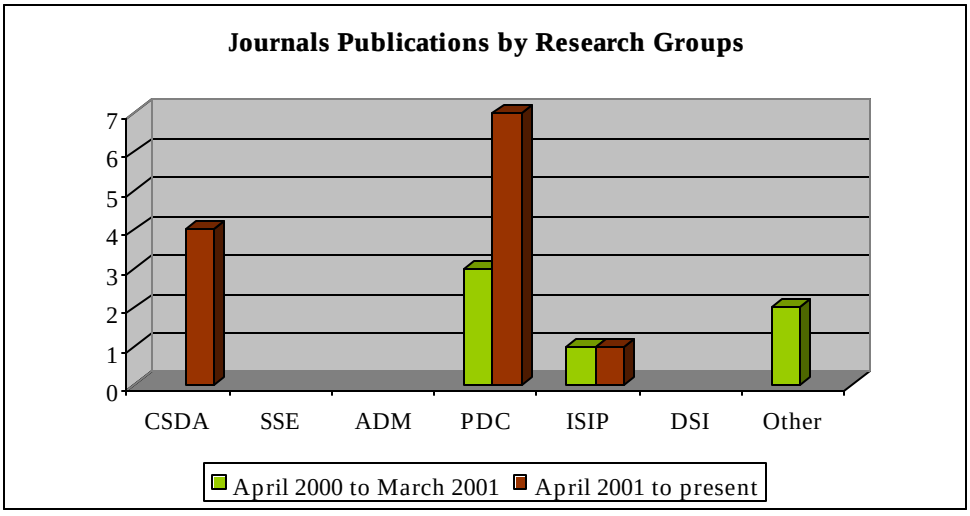
Our outcome assessment strategy involves internal an external assessment. Internal assessment will be conducted through an assessment team formed by faculty. This team will study the project goals and objectives and develop assessment criteria, and tools. Some performance indicators have been identified. The team will analyze the project results and provide feedback to the stakeholders of the project. This section provides various graphics that show the performance in publication efforts as well as the degree of student participation.

1.0 Publications



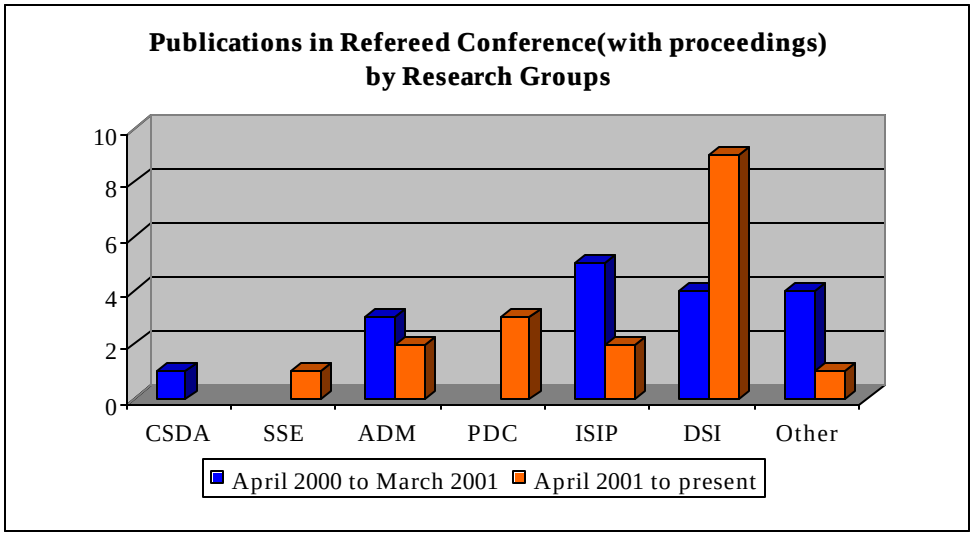
	April 2000 to March 31, 2001	April 1, 2001 to present
Total	20	30
Journal	6	12

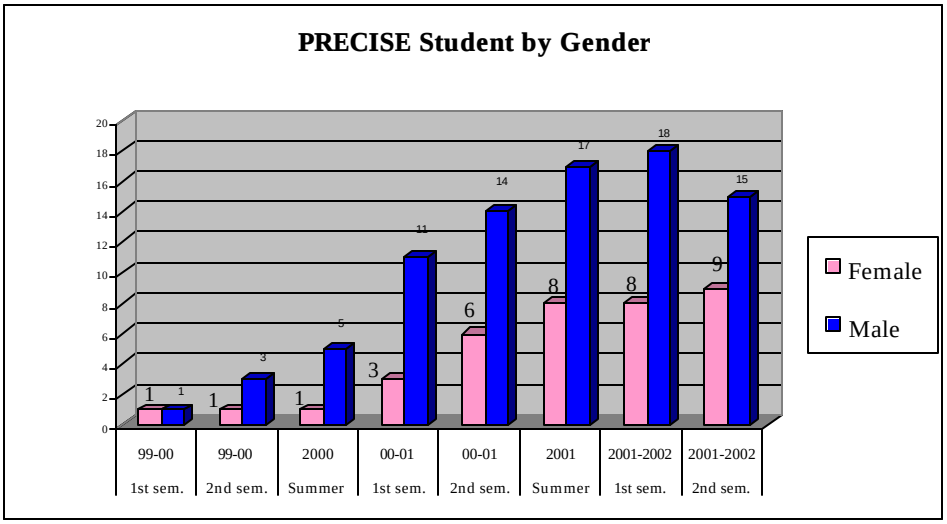
An increase in number of publications has been experienced (from 20 to 30 for April 2000 to March 2002). In addition, the percentage of journal publications has shown an increase from 6 to 12 or 100% for the same period. We also noted that one student (woman) has figured as first author in a refereed journal.



The Parallel and Distributed Computing (PDC) was the research group that presented the greater quantity of the publications submitted and accepted during this year, followed by Computational Statistics and Data Analysis (CSDA).

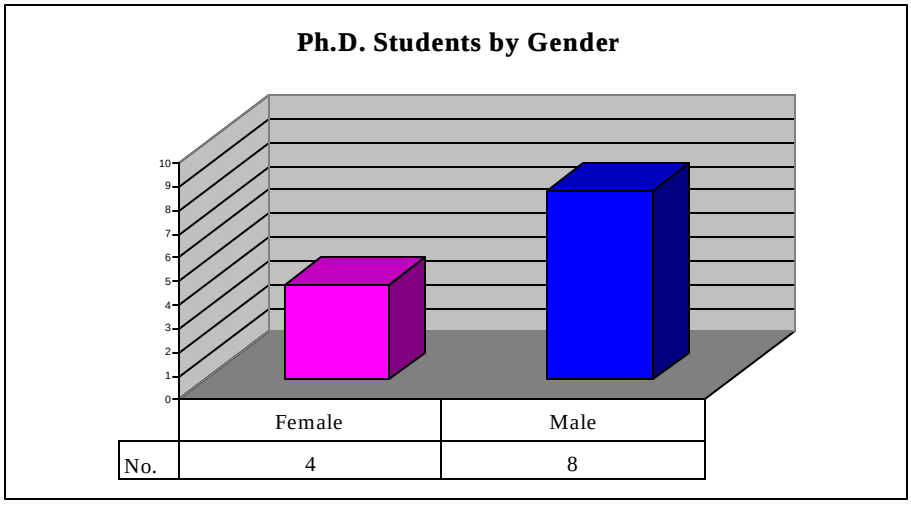
The graphic to the right shows the research activity of our PRECISE groups and confirms the participation in refereed international conferences with proceedings.





One of the vital points of interest of PRECISE Project is the woman participation in CISE research activities and graduate programs. The graphic to the left shows the increase in women participation through the economic and overall support provided by PRECISE.

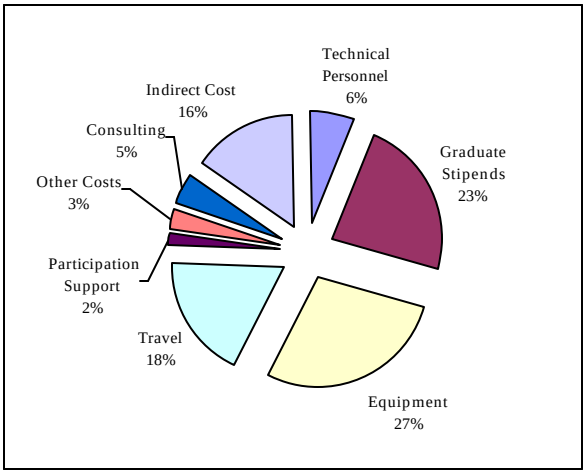
One of the project's successes is the creation and support of the Ph.D. CISE program. We evaluate our achievement through the 33% of women that at present are pursuing their doctoral degree.



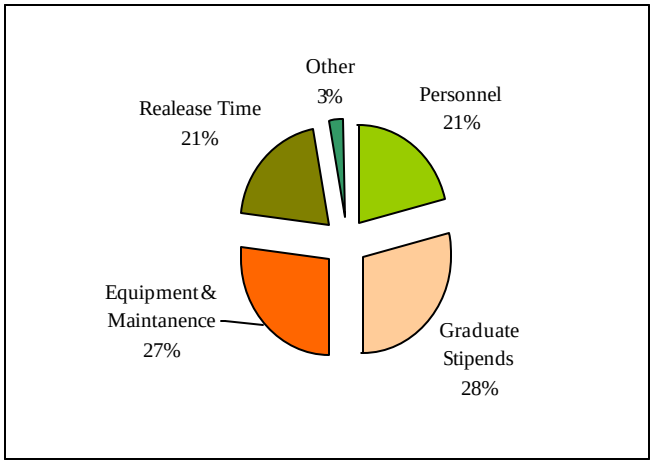
Part H: Budget - FUNDS DISTRIBUTIONS

This section provides a description of our budget activities for the past year. The portions of the budget used and available as of March 31st are presented in the graphs and tables below.

NSF Budget Distribution



UPR Budget Distribution



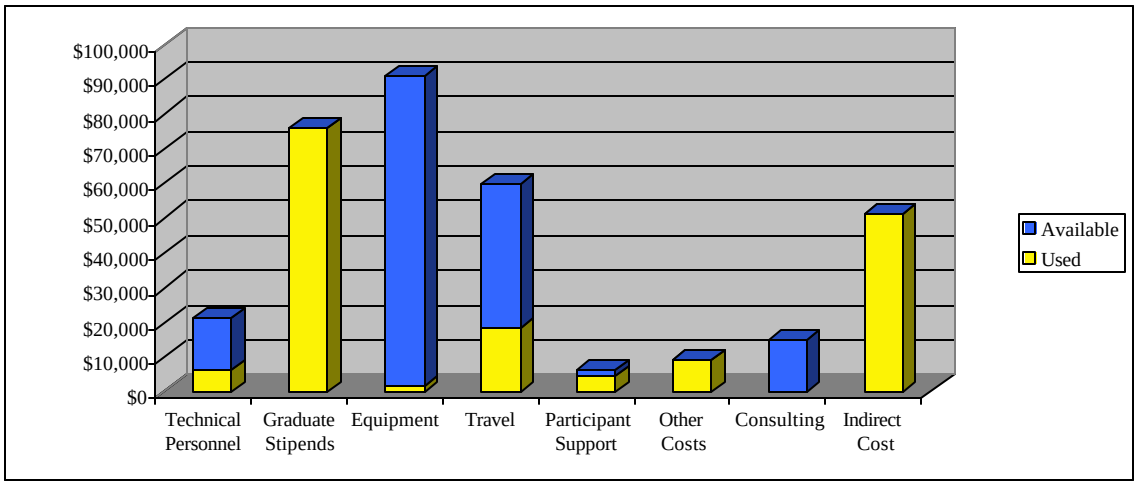
The portions of the budget used and available as of March 31st are presented in the table below.

NSF Contribution	Original	Used	Available
Technical Personnel	21,105	6,235	14,870
Graduate Stipends	76,050	75,884	166
Equipment	91,000	1,505	89,495
Travel	60,000	18,660	41,340
Participant Support	6,000	4,433	1,567
Other Costs	9,000	9,000	0
Consulting	15,000	0	15,000

UPR Contribution	Original	Used	Available
Graduate Stipends	63,120	63,120	0
Personnel	85,567	70,268	15,299
Equipment & Maintenance	80,000	5,462	74,538
Release Time	61,510	61,510	0
Other	8,000	0	8,000

With NSF and UPR funds combined we were able to provide assistantships to 19 master students and 3 PhD Students. We were able to contract a technician for updating and maintaining our website. Travel funds were used for professors Jaime Seguel, Jorge Ortiz and Domingo Rodriguez to attend conferences and workshops. In addition Student Viviam Murillo was able to travel to Boston to conduct a usability study and professor Domingo Rodriguez was able to visit NSF during the spring. The travel funds left will be used to cover travel expenses for researchers to attend conferences and workshops during this semester and the summer. Funds were used for the organization and celebration of CRC 2002 and for purchasing materials and supplies. A very little amount was used for equipment. However, the remaining funds will be used for planed equipment purchases. The funds for consulting will be used to pay consulting fees to our collaborators from the Harvard Medical School and for covering some of the travel expenses of professor Nestor J. Rodriguez and a graduate student to conduct usability studies at the Beth Israel Deaconess Medical Center in Boston this summer. The following chart shows the relationship between the used and available NSF funds for this year.

Used and Available NSF



With the UPR budget we were able to hire a secretary, two administrative assistants and a part time system administrator. The personnel funds left will be used to pay summer salaries for the Outreach Coordinator and the Assessment Coordinator. A very little amount was used for equipment. The available funds will be used for planed equipment purchases. In-kind funds were used to provide three credits release time for five researchers during the academic year. The following chart shows the relationship between the used and available UPR funds for this year.

Used and Available UPR Funds