Applied Mathematics Research Center

Delaware State University Applied Mathematics Research Center (AMRC) was initially funded by the Department of Defense (DoD) in 2003. AMRC is designed to create a research environment where multidisciplinary groups work together to solve applied mathematics problems in military and other areas. The research center consists of faculty of Mathematics, Computer Science, Electrical Engineering, and Biotechnology, research associates, visiting professors and an administrative assistant.

The major goals are:

- to establish a permanent research base at Delaware State University which produces new knowledge and quality, publishable, peer-reviewed research relevant to DoD research goals
- to enhance participation and substantial involvement of minority graduate (M.S. and Ph.D.) and undergraduate students and faculty in Science and Mathematics research
- to provide additional training in mathematics and sciences to minority female high school students by involving them a summer program (GEMS), and therefore to prepare more minority students (especially women) in sciences and mathematics
- to foster long-term research collaboration among scientists with Army Research Laboratories, and other national government and academic institutions; and 5) to ensure long term sufficient research funding

MAIN RESEARCH AREAS

Ground Penetrating Radar Imaging

Buried object detection using GPR has attracted tremendous attention in the past decades because of its important military, such as mine detection, and commercial applications. Our current work aims to use vector multiresolution representation for the antenna array receiving data in multifrequency ground penetrating radar (GPR), and solves the inverse scattering problem, and then uses the hidden Markov model (HMM) in the wavelet transform domain for the target detection. We plan to expand our GPR imaging research in three aspects:

1. continuing to investigate our current research targets;
2. developing algorithms for 3-D GPR imaging; and
3. processing real land mine GPR data with new algorithms.

The NURBS methods of Computer geometric design in automatic representing 3D objects

NURBS is the most popular and widely used method and tool in the field of computer geometric design in representing and manipulating 3D objects. The objectives of the project are to study the following problems in reconstruction of smooth surfaces, which are:

1. producing polygonal model from scattered and unstructured 3D data, and/or even from 2D data;

2. mesh quadrilaterization of the polygonal model; and
3. the representation of the parametric surfaces on each quadrilateral patch, and the construction of NURBS surface model.

Image Registration

The research task is to develop software in C or MATLAB that will create a unified image from a sequence of smaller images. The dyadic combination of images is the basic operation; the recursive implementation of this combination will constitute the desired algorithm. A data set of the Blossom Point test range will be used as the data source. We will identify relevant features that allow images to be merged. It is expected that these features will also be applicable to similar images. This software will be developed with the expectation that it will be enhanced to include problems associated with scaling, and then 3D image reconstruction.

Signal Processing in Data Mining

The ultimate goal of the proposed research is to provide advances in technology towards successful development, testing, refinement and application of intelligent, self-adaptive software systems. The approaches integrate computer vision systems, soft computing and evolutionary computational paradigms, complex adaptive software structures and robust machine learning algorithms. In addition, we aim towards practical design, development, prototyping and evaluation of a knowledge-based software system that will integrate theoretical aspects of the proposed techniques into user-friendly application equipped by advanced user interface and enhanced data base management capabilities.

Biotechnology

The research focuses on nucleotide sequence and chromatin structure requirements for integration. We will also deal with the scientific, social, and ethical issues related to the field of Biotechnology, present the elements of biostatics and numerical methods needed for quantitative data analysis and interpretation, and provide practical experience with the use of software and databases in the investigation of problems critical to biotechnology and molecular biology to our undergraduate students.

Other Research Areas

Inverse Ill-Posed Problems, Numerical Analysis, Partial Differential Equations, Integral Equations, Wavelets and Image Analysis, Scientific Computation, and Mathematical Physics.

Outreach

Delaware State University (DSU) will conduct the pre-college program ***Girls Explorations in Mathematics and Science (GEMS)***. GEMS is a three-week summer residential program involving hands-on explorations in mathematics, biology, and information technology with research activities. This project will offer 20 motivated high-potential female high school students entering tenth and eleventh grades an opportunity to integrate and apply concepts from these disciplines to problem solving. GEMS program is designed to stimulate and extend students' interest in these fields and encourage them to investigate careers in mathematics, biology, and information technology. This addresses the problem of under-representation of women, in particular minorities, in these fields. Three college professors and three high school teachers, who are assisted by six undergraduate/ graduate female students, conduct the project. The curriculum has been carefully designed to expose students to research methodology, to enable them to see the connections between mathematics, biology, and information technology. The participants work in small groups and use computers extensively to explore and discover mathematical and biological concepts.

Department Homepage ***[1]***

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Links
[1] http://www.desu.edu/department-mathematics