Mathematical and Computational Sciences

Editors
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Narosa

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Preface

Mathematical and computational sciences is an important area of research. There are several research issues in computer science, for which mathematical solutions are the simplest. Many problems arising from the real world can be brought in a form of mathematical equation using mathematical modeling. The inverse and ill-posed problems can be applied in the areas of image and signal processing, data mining, sensor network etc., for solution. Graph theory finds extensive applications in network problems, including routing issues. The solution for some problems can be found in closed form only in special cases. This conference discusses these and similar issues. Several eminent scholars from various reputed institutes in India and abroad, are taking part in this conference to handle sessions on such issues. The participants are from various disciplines like mathematics, computer science, electronics and electrical engineering.

The conference is organized in honour of Prof. R. J. D'Souza, who has been with the department of Mathematical and Computational Sciences, National Institute of Technology, Karnataka for forty-two years and is retiring on superannuation in January 2015. This was a motivation in organizing the International Conference on Mathematical Sciences and Computational Sciences (ICMACS-2015) at Don Bosco College, Kerala during January 22-24, 2015. The concept of this conference was the brain child of his students and lose associates, at his superannuation. Precisely for this reason, the themes of this conference have been aligned with his research interests, which are carried forward by his students.

We would like to thank the program chairs, organization staff, and members of the program committees, for their hard work. We also thank the reviewers whose expertise is reflected in the quality of the papers. The financial support given by the National Board of Higher Mathematics is gratefully acknowledged. EMC^2, a leading multinational company supported the conference with technical collaboration. Narosa Publishing House was kind enough to publish the proceedings of the conference. We are also grateful to Inderscience Publishers for hosting special issues on the conference theme.

We hope that all participants and other readers benefit from the proceedings.

Santhosh George
Jidesh P.
Johny Jose

Contents

ABSTRACTS OF THE INVITED TALKS

MATHEMATICAL SCIENCES

Ray, Radon, Fourier Transforms and Inverse Problem in Image Reconstruction

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Abstract

In this talk, we introduce Ray and Radon transforms in the context of Tomogrpahic reconstruction. We will see how Fourier transform is used in inverting the Radon transform. Tomography is a cross sectional imaging of an object or tissue from the mathematical modelling and measured experimental data. The study of tomography involves mathematical modelling, analysis, development of numerical algorithms and its implementation and experimental validation. These problems lead to a class of inverse problems where the mathematical analysis and computations are rather complicated. Here, we plan to present a general introduction to tomography beginning with X-ray tomography and if time permits, move on to other tomographies like diffuse correlation tomography (DCT), ultrasound modulated optical tomography (UMOT). Most of the talk will be addressed to cater the general audience both from engineering and science. In our tour of tomography, you may get to see the importance of analysis like Radon transform, Fourier transform, various PDEs.

The Role of Best Approximation Theory in the Study of Fixed Point Theorems

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Abstract

In this talk it is intended to review the recent work done in Ky Fan Type best approximation theorems and best proximity point theorems . We will also indicate some applications of Ky Fan type best approximation theorems and best proximity point theorems .

A superconvergent method to solve a nonlinear operator equation

Grammont Laurence
Professor, Université Jean Monnet, Member of Université de Lyon,
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Abstract

Consider a nonlinearÂă operatorÂă equation $x-K(x)=f$; where K is a Urysohn integral operator. Using the orthogonal projection onto a space of discontinuous piecewise polynomials of degree r, previous authors have established an order $r+1$ convergence for the Galerkin solution and $2r+2$ for the iterated Galerkin solution. Equivalent results have also been established for the interpolatory projection at Gauss points. In this talk, a modified projection method is shown to have convergence of order $3r+3$: The size of the system of equations that must be solved, in implementing this method, remains the same as for the Galerkin method.

Linearization versus Discretization, which should be done first ?

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Abstract

For some discretization procedures such as NystrÃűm method and Kantorovich method for solving numerically nonlinear integral equations, linearization by Newton's method should be done on the continuous infinite dimensional problem, and discretization only at each step of Newton's scheme in order to obtain a sequence of approximations which is convergent to the exact solution of the nonlinear initial problem. We prove this assertion and we give numerical evidence.

Approximate Solutions of Integral Equations

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Abstract

In this Survey talk, we consider an integral equation

$$xK(x) = f, \tag{0.1}$$

where K is either a linear integral operator or a non-linear Urysohn integral operator defined on $L^\infty[0,1]$. It is assumed that the above equation has a unique solution φ and we are interested in computable approximate solutions of (0.1). Let $r \geq 0$ and let X_n be a space of piecewise polynomials of degree $\leq r$ with respect to an uniform partition of $[0,1]$. Using a projection operator onto the finite dimensional subspace X_n, the integral operator K is replaced by a continuous finite rank operator K_n and an approximate solution φ_n of (0.1) is obtained. We discuss classical methods such as Galerkin/collocation methods and their iterated versions and some methods of recent origin. The orders of convergence of φ_n to the exact solution φ, the phenomenon of the superconvergence and asymptotic series expansions of approximate solutions are of particular interest.

Van der Waerden's Theorem: A pearl of Number Theory

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Abstract

We present the van der Waerden's classical theorem on arithmetic progressions which states: Given two arbitrary natural numbers k and l, there exist a natural number $n(k,l)$ such that if an arbitrary segment of of length $n(k,l)$ of the sequence of natural numbers is divided in any manner into k classes, then an arithmetic progression of length l appears in at least one of the classes. The least value of $n(k,l)$ is called the van der Waerden number, named after the Holland mathematician B. L. van der Waerden. This result which proved to be a major impetus in the development of Combinatorial Number Theory is one of the pearls that Khinchin presented in his âĂIJThree Pearls of Number TheoryâĂİ.

References:

1) A. Y. Khinchin, Three Pearls of Number Theory, Graylock Press, 1952.

2) S. D. Adhikari, Aspects of Combinatorics and Combinatorial Number Theory, Narosa Publishing House, 2003.