Research Scholar Seminar and Annual Conference of the Society of Mathematical Sciences (Delhi)

May 01-02, 2017

UGC-SAP/DST-FIST/DST-PURSE

Department of Mathematics

University of Delhi, Delhi 110 007, India

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Dr. Atul Gaur

University of Delhi

Contents

About the Department

In University of Delhi, Department of Mathematics was started in 1947 and in 1957 a post-graduate course in Mathematical Statistics was initiated. The department was therefore renamed as Department of Mathematics and Mathematical Statistics. In 1963 a two year postgraduate course in Operational Research was instituted under this department. As such the department expanded considerably and so did its activities. Consequently in December 1964 the Faculty of Mathematics was formed and in August 1973 the only department under the Faculty was divided into four departments, viz., Department of Mathematics, Department of Statistics, Department of Operational Research, and Department of Computer Science.

The impressive tradition of the Department of Mathematics derives its roots from the east which predates the formation of the post graduate department. Encompassed within the tradition are names such as P. L. Bhatnagar, J. N. Kapur, A. N. Mitra, and B. R. Seth, all of whom distinguished themselves by their teaching and research and who later carved out major roles for themselves on the Indian mathematical scenario even though they were not directly associated with the post-graduate department.

The post-graduate department was set up in 1947. It was fortunate to have Professor Ram Behari as its first head. Prof. Ram Behari was an eminent mathematician who specialised in the important field of Differential Geometry. He can be credited with having started the tradition of research in Differential Geometry, one of the first disciplines in pure mathematics to have been pursued in the department. He guided a number of research scholars and established the high traditions of teaching in the department. During his tenure, in 1957, the department also initiated an M.A./M.Sc. program in Mathematical Statistics and the department was designated as the Department of Mathematics and Mathematical Statistics.

In 1962, the department was given a formidable push when a distinguished mathematician, Prof. R. S. Varma, assumed the responsibilities of the head. It was entirely due to his dynamism and academic breadth that research activities in the department blossomed in several directions such as Operational Research, Information Theory, Coding Theory, Space Dynamics and in Complex Analysis. The first masters program in Operational Research in the country was started in this department under his leadership. This was even before any university in the U.K. and in several other advanced countries had done so. Since the activities and the courses in the department were now so wide and varied the department was enlarged into the Faculty of Mathematics at the initiative of Prof. R. S. Varma and he was appointed as the first Dean.

In 1970, another distinguished mathematician, Prof. U. N. Singh, was appointed

the Head of the Department and the Dean of the Faculty of Mathematics. He provided the department with the requisite strength and depth in the core areas of mathematics. He created strong research in Functional Analysis, Harmonic Analysis, and in Operator Theory. During his stewardship of the department, several distinguished mathematicians from all over the globe began to visit the department regularly and the department can be said to have attained full maturity. He foresaw the need to have separate departments within the overall set-up of the Faculty of Mathematics and thus were created, in 1973, the Department of Mathematics, the Department of Statistics, the Department of Operational Research and the Department of Computer Science. The Faculty of Mathematics was re-designated as the Faculty of Mathematical Sciences.

The Department currently offers M.A./M.Sc. courses and runs M.Phil., and Ph.D. programs in Mathematics.

Faculty and their Research Specializations

The area(s) of expertise of the faculty members of the department are given below

Professors	
Dinesh Singh dsingh@maths.du.ac.in	Banach Algebras, Complex Analysis, Functional Analysis
Tej B. Singh tbsingh@maths.du.ac.in	Algebraic Topology
Ajay Kumar akumar@maths.du.ac.in	Harmonic Analysis, Complex Analysis, Operator Algebras
V. Ravichandran (HOD) vravi68@gmail.com	Complex Analysis
Tarun Das tarukd@gmail.com	General Topology, Dynamical systems and Ergodic Theory
C. S. Lalitha cslalitha1@gmail.com	Mathematical Programming, Optimization Theory
Ruchi Das rdasmsu@gmail.com	General Topology, Dynamical Systems and Ergodic Theory
Associate Professors	
Sachi Srivastava sachi_srivastava@yahoo.com	Functional Analysis, Operator Theory, Abstract Differential Equations, Operator Algebras
Vusala Ambethkar vambethkar@maths.du.ac.in	Computational Fluid Mechanics

Assistant Professors	
Ratikanta Panda rkpanda@maths.du.ac.in	Analysis of PDE, Nonlinear Functional Analysis
A. Zothansanga azothansanga26@yahoo.com	Functional Analysis
Lalit Kumar lalitkvashisht@gmail.com	Frames, Wavelets, Functional Analysis
Anupama Panigrahi anupama.panigrahi@gmail.com	Number Theory, Cryptography, Information Security
Arvind Patel apatel@maths.du.ac.in	Fluid Dnamics, Computational Fluid Dynamics, PDE
Kanchan Joshi kanchan.joshi@gmail.com	Algebra: Non-Commutative Group Rings
Atul Gaur agaur@maths.du.ac.in	Commutative Algebra
Hemant Kumar Singh hksinghdu@gmail.com	Algebraic Topology
Anuj Bishnoi anuj.bshn@gmail.com	Field Theory and Polynomials
Pratima Rai pratimarai5@gmail.com	Numerical analysis, Differential equations
Sachin Kumar sachinambariya@gmail.com	Differential Equations, General Relativity
Surendra Kumar surendraiitr8@gmail.com	Ordinary differential equations, Systems theory; control
Ranjana Jain rjain.math@gmail.com	Functional Analysis, Operator Spaces, Operator Algebras
Randheer Singh randheernsit@gmail.com	Partial Differential Equations, Nonlinear Waves

Programme

Day 1: May 01, 2017

Venue: Room No. 5, Satyakam Bhavan

08:00AM - 09:00AM	Registration
09:00AM - 09:30AM	Inaugural function
Session I: Invited Talks	
09:30AM - 10:30AM	*Turan inequalities for functions of hypergeometric type* Dr. A. Swaminathan Indian Institute of Technology, Roorkee **Chair:** Prof. V. Ravichandran
10:30 AM – 11:00 AM High Tea	
11:00AM – 12:00PM	*Fourth-order compact scheme for partial-differential equations: Application in Finance* Dr. Mani Mehra Indian Institute of Technology, Delhi **Chair:** Dr. Arvind Patel
12:00PM – 01:00PM	**Session II:** Paper Presentation
01:00 PM – 02:00 PM Lunch	
02:00PM – 03:30PM	**Session III:** Paper Presentation
03:30PM – 04:00PM Tea Break	
04:00PM – 05:00PM	**Session III:** Paper Presentation

Day 2: May 02, 2017

Venue: Room No. 5, Satyakam Bhavan

Session I: Invited Talks	
09:30AM - 10:30AM	*Derivatives and perturbation bounds for operator functions* Dr. Tanvi Jain Indian Statistical Institute, Delhi **Chair:** Dr. Sachi Srivastava
10:30 AM – 11:00 AM High Tea	
11:00AM – 01:00PM	**Session II:** Paper Presentation
01:00 PM – 02:00 PM Lunch	
02:00PM – 03:30PM	**Session III:** Paper Presentation
03:30PM – 04:00PM	**Tea Break**
04:00PM	**Valedictory function**

Paper Presentations

Day 1: Monday, May 01, 2017

Session II: Paper Presentation
Time: 12:00 PM – 01:00 PM

Chair: Dr. R. Panda

1. Qualitative Uncertainty Principle for Gabor Transform on Certain Locally Compact Groups
   Jyoti Sharma

2. Supercyclic C_0-semigroups and somewhere dense orbits
   Abhay Kumar

3. Some Remarks on Generalized Slant Hankel Operators
   Anshika Mittal

4. Shock wave structure in a viscous non-ideal gas under heat-conduction and radiation heat flux
   Manoj Singh

Session III: Paper Presentation
Time: 02:00 PM – 03:30 PM

Chair: Dr. Surendra Kumar

1. On slant weighted Toeplitz operators
   Neelima Ohri

2. Normality Criteria for a Family of Meromorphic Functions with Multiple Zeros
   Poonam Rani

3. Hardy's Theorem for Gabor Transform
   Ashish Bansal

4. Cones associated with frames in Banach spaces
   Shah Jahan

5. Newton-Type Iterative Methods For Finding Zeros Having Higher Multiplicity
   Kriti Sethi

6. High accuracy compact difference scheme for the fourth order parabolic partial differential equation
   Deepti Kaur

Session IV: Paper Presentation
Time: 04:00 PM – 05:00 PM

Chair: Dr. Atul Gaur

1. Solving Elliptic Curve Discrete Logarithmic Problem With Improved Baby-Step Giant-Step Algorithm
   Atul pandey

2. Maximal subrings of a ring
   Rahul Kumar

3. The stability of a nonmultiplicative type sum form functional equation
   Shveta Grover

Day 2: Tuesday, May 02, 2017

Session II: Paper Presentation
Time: 11:00 AM – 01:00 PM

Chair: Prof. C. S. Lalitha

1. On Multi-objective Fractional Variational Problem Using Higher Order Efficiency
   Bharti Sharma

2. Scalarizations for a unified vector optimization problem based on the order representing and the order preserving properties
   Khushboo

3. Using Linear Programming in Solving the Problem of Services Company's Costs
   Divya Chhibber

4. Sufficiency and Duality for a class of Interval-valued Programming Problem
   Jyoti

5. Pointwise well-posedness in set-valued optimization
   Mansi Dhingra

6. Mathematical description of some facts related to agricultural sector
   Neetu Rani

Session III: Paper Presentation
Time: 02:00 PM – 03:30 PM

Chair: Prof. Ruchi Das

1. Combination synchronization of chaotic dynamical systems
   Aysha Ibraheem

2. A remark on extremally μ-disconnected generalized topological spaces
   Harsh V. S. Chauhan

3. Expansive Behaviour of Measures
   Pramod Kumar Das

4. Directional convexity of harmonic mappings
   Subzar Beig

Abstracts

Turan inequalities for functions of hypergeometric type

A. Swaminathan

mathswami@gmail.com
Department of Mathematics,
Indian Institute of Technology, Rorkee

The well known Turan inequality for Legendre Polynomial is extended by many authors to various orthogonal polynomials and related hypergeometric type special functions. In this talk, certain recent developments in this direction together with the literature involved are provided.

Fourth-order compact scheme for partial-differential equations: Application in Finance

Mani Mehra

manimeh@gmail.com
Department of Mathematics,
Indian Institute of Technology, Delhi

An unconditionally stable compact finite difference scheme is proposed for the solution of convection-diffusion equations. Proposed compact scheme is fourth order accurate in spatial variable and second order accurate in temporal variable. Consistency, stability and convergence of the proposed compact finite difference scheme is proved and it is shown that proposed compact finite difference scheme is unconditionally stable. As an application in finance, proposed compact scheme is applied to the Asian option partial-differential equation (falls in the category of convection-diffusion equation). It is shown that for a given accuracy, proposed compact scheme is significantly efficient as compared to the central difference scheme. Moreover, proposed compact scheme is associated with wavelets to produce wavelet optimized compact finite difference (WOCFD) method for PDEs which deals with non-smoothness of initial condition and provides solution on the adaptive grid.

Derivatives and Perturbation Bounds for Operator Functions

Tanvi Jain

tvi.jain@gmail.com
Department of Mathematics,
Indian Statistical Institute, Delhi

We will discuss the differentiation of functions defined on bounded operators on Hilbert spaces, especially the power functions, and also discuss the computation of the norms of their derivatives and the perturbation bounds for these functions.

Supercyclic C_0-semigroups and somewhere dense orbits

Abhay Kumar

abhaykumar288@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007

We show that if a C_0-semigroup $(T_t)_{t\geq 0}$ with generator A, admits a somewhere dense projective orbit then the point spectrum of A^* contains at most one point. In particular, the adjojnt of the generator of a supercyclic semigroup has this property.

The stability of a nonmultiplicative type sum form functional equation

Shveta Grover

srkgrover9@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007

This paper deals with the stability of the sum form functional equation containing two unknown real valued mappings.

Weaving K-Fusion Frames in Hilbert Spaces

Saakshi Garg

saakshi.garg@yahoo.com
Department of Mathematics,
University of Delhi,
Delhi 110 007

Motivated by a new concept of weaving frames in separable Hilbert spaces by Bemrose, Casazza, Gröchenig, Lammers and Lynch [Weaving Frames, Oper. Matrices, 10 (4) (2016), 1093–1116], we study weaving properties of K-fusion frames in a Hilbert space $\mathcal{H}$. We provide a necessary and sufficient condition for weaving K-fusion frames for $\mathcal{H}$ in terms of a bounded linear operator on $\mathcal{H}$, and give an applicative example. A Paley-Wiener type perturbation result for weaving K-fusion frames is given. Finally, a necessary and sufficient condition for weaving K-fusion frames provides an explicit expression for K associated with a sequence from the representation space.

High accuracy compact difference scheme for the fourth order parabolic partial differential equation

Deepti Kaur

deeptimaths15@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110007

Fourth order parabolic partial differential equations occur in various mathematical models of physical problems in science and engineering ranging from vibrations of a homogenous beam to propagation of shallow water waves. Numerical scheme based on off-step discretization is developed to solve one space dimensional fourth order parabolic partial differential equation subjected to appropriate initial and boundary conditions. The method is based on only three spatial grid points, meaning that no fictitious points are required for incorporating the boundary conditions. For a fixed mesh ratio parameter ($\triangle t/\triangle x^2$), the proposed method behaves like a fourth order method in space. The essence of the method lies in the fact that it is directly applicable to singular problems. The numerical scheme has been applied to test Euler Bernoulli beam equation, good Boussinesq equation and singular problem. The illustrative results corroborate the theoretical order of magnitude and accuracy of the method.

Some Remarks on Generalized Slant Hankel Operators

Anshika Mittal

anshika0825@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007

In the year 2002, Avendano introduced the notion of λ-Hankel operators as those operators X which satisfy the operator equation $S^*X - XS = \lambda X$, where S denotes the unilateral forward shift on H^2. Avendano also described the solution of the equation $\lambda S^*X = XS$ as λ-Hankel operators in a different approach. Motivated by the work of Avendano and Barria and Halmos, another class of operators was discussed by G. Datt and R. Aggarwal which involved the study of operator equation $\lambda M_{\bar{z}}X = XM_{z^k}$ for $\lambda \in \mathbb{C}$ and $k \geq 2$ along with some spectral properties of the solutions of this equation. We call the solution of this equation as generalized λ-slant Hankel operators of k^{th}-order. For k=2, the solutions of equation $\lambda M_{\bar{z}}X = XM_{z^2}$ are simply called generalized λ-slant Hankel operators.

Motivated by these developments, in this paper we introduce and study the notion of essentially generalized λ-slant Hankel operators of k^{th}-order on the space L^2 which is nothing but an operator X which satisfies the operator equation $\lambda M_{\bar{z}}X - XM_{z^k} = K$, for some compact operator K on L^2 along with their compressions on the space H^2. We also study compressions of generalized λ-slant Hankel operators of k^{th}-order on the space H^2 and their spectrum.

On slant weighted Toeplitz operators

Neelima Ohri

ohri.neel@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007

For a positive integer $k \geq 2$, the k^{th}-order slant weight-ed Toeplitz operator $U^{\beta}_{k,\phi}$ on $L^2(\beta)$ with symbol $\phi \in L^{\infty}(\beta)$ is defined as $U^{\beta}_{k,\phi} = W_k M^{\beta}_{\phi}$, where $W_k e_n(z) = \frac{\beta_m}{\beta_{km}} e_m(z)$ if $n = km, m \in \mathbb{Z}$ and $W_k e_n(z) = 0$ otherwise. If $\{\frac{\beta_{kn}}{\beta_n}\}_{n\in\mathbb{Z}}$ is bounded, then the k^{th}-order slant weighted Toeplitz operators on $L^2(\beta)$ are characterized as the solutions X of the operator equation $M^{\beta}_z X = XM^{\beta}_{z^k}$. We introduce and study the notion of an essentially k^{th}-order slant weighted Toeplitz operator on $L^2(\beta)$, via the operator equation

$$M^{\beta}_z X - XM^{\beta}_{z^k} = K,$$

for some compact operator K on $L^2(\beta)$. We attempt to investigate some of the properties of this operator and also study its counterpart on $H^2(\beta)$.

Normality Criteria for a Family of Meromorphic Functions with Multiple Zeros

Poonam Rani

pnmrani753@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110007

In this article, we prove some normality criteria for a family of meromorphic functions having zeros with some multiplicity. Our main result involves sharing of a holomorphic function by certain differential polynomials. Our results generalize some of the results of Fang and Zalcman and Chen et al to a great extent.

Combination synchronization of chaotic dynamical systems

Aysha Ibraheem

ayshaibraheem74@gmail.com
Department of Mathematics,
University of Delhi, Delhi 110007

This paper presents synchronization between three different chaotic systems. Chaotic Lu system and T system are considered as master system and chaotic Chen system is considered as slave system. Nonlinear control method and Lyapunov stability theory are used to achieve desired combination synchronization. Graphical results are presented to verify the proposed approach. Chaotic behavior of all systems are shown by plotting Lyapunov exponents. All graphs are executed in Matlab environment. Theoretical and numerical results are in agreement

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Newton-Type Iterative Methods For Finding Zeros Having Higher Multiplicity

Kriti Sethi

kritisethi@students.sau.ac.in
Department of Applied Mathematics,
South Asian University,
New Delhi 110021

In this seminar, we will discuss some numerical methods for solving non-linear equations $f(x) = 0$ having zeros of higher multiplicity. We use the idea of Gander and obtain families of several iterative methods. The families of methods includes methods of Newton type, Steffensen type and their variant. We obtain families of methods of order 2 as well as 3.

A remark on extremally μ-disconnected generalized topological spaces

Harsh V. S. Chauhan

harsh.chauhan111@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007, India.

A more general definition of extremally μ-disconnected generalized topological space is introduced and its properties are studied. We have further improved the definitions of generalized open sets and upper(lower) semi-continuous functions defined for generalized topological space. In this generalized framework we obtainsome analogous results. Examples of extremally μ-disconnected generalized topological spaces are given.

Scalarizations for a unified vector optimization problem based on the order representing and the order preserving properties

Khushboo

thakurkhushboo4@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007

The aim of this paper is to study the characterizations of minimal and approximate minimal solutions of a unified vector optimization problem via scalarizations which are based on general order representing and order preserving

properties. We show that an existing nonlinear scalariation, using the Gerstwitz function, is a particular case of the proposed scalarization. Furthermore, in

case of normed space, using the well known oriented distance function, characterizations of minimal solutions are established. Also, we show that the oriented

distance function satisfies the order representing and the order preserving properties under suitable assumptions.

Hardy's Theorem for Gabor Transform

Ashish Bansal

mr.ashishbansal@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007, India.

In this talk, we shall discuss Hardy's theorem for Gabor transform on locally compact abelian groups having non-compact identity component, $R^n \times K$ (where K is a compact group with bounded representations) and connected nilpotent Lie groups.

Solving Elliptic Curve Discrete Logarithmic Problem With Improved Baby-Step Giant-Step Algorithm

Atul pandey

apandey@maths.du.ac.in
Department of Mathematics,
University of Delhi,
Delhi 110 007

In this paper, we modify the worst case and average case complexity using efficient inversion of BSGS.

Expansive Behaviour of Measures

Pramod Kumar Das

pramod.math.ju@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110007

Will define μ-expansive map by extending one of the fundamental and mostly studied concepts in dynamical systems called expansive homeomorphism on a separable metric space without isolated points. Will show that equicontinuous homeomorphisms and μ-expansive homeomorphisms are disjoint. It will also be shown that there does not exists any μ-expansive homeomorphism on unit compact interval. Will discuss several other results regarding stable classes, sinks and sources of a μ-expansive system.

Using Linear Programming in Solving the Problem of Services Company's Costs

Divya Chhibber
divyachhibber@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110007

In today's competitive world, markets are outside the geographical boundaries of their traditional mode and manufacturers attempt to provide their products in all global regions with lowest cost. In recent years, providing a proper service has been one of the most important factors in customer satisfaction that is one of the things that imposes large costs to companies and appropriate policies can prevent such of these unnecessary costs. My Research paper aims to solve transportation problem using linear programming in a services company.

Mathematical description of some facts related to agricultural sector

Neetu Rani
neetu.october@gmail.com
Shivaji College, Department of Mathematics,
University of Delhi, Delhi 110007

Agricultural sector is one of the important segments for growth of economy of a country and thus needs major attention for its continuous nourishment. In India, though more than 50people are engaged in agriculture but this sector is losing its appeal in youth. Youth in the villages is getting attracted towards the non-agricultural sector, and this has been discussed with the aid of mathematical tools. A time dependent mathematical model for studying the problem has been formulated. Numerical solution for a particular situation has also been shown graphically using mathematical software. To get deeper insight into the problem, few mathematical parameters have also been represented graphically.

Qualitative Uncertainty Principle for Gabor Transform on Certain Locally Compact Groups

Jyoti Sharma
sharmajyoti22nov@gmail.com
Department of Mathematics,
University of Delhi, Delhi 110007

Several classes of locally compact groups having qualitative uncertainty principle for Gabor transform will be discussed. These include Moore groups, Heisenberg group $\mathbb{H}_n$, $\mathbb{H}_n \times D$ (where D is discrete group) and other low-dimensional nilpotent Lie groups.

Maximal subrings of a ring

Rahul Kumar

rahulkmr977@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007, India.

We discussed a property of a ring and its maximal subrings with the help of an example.

Cones Associated with Frames in Banach Spaces

Shah Jahan

chowdharyshahjahan@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007, India.

In this paper we define cones associated with a Banach frame and gave examples for their existence. A sufficient condition and a necessary condition for a cone associated with a Banach frame to be a generating cone has been given. Also, we prove that a cone associated with an exact Banch frame necessarily has an unbounded base and an extremal subset but it has no weakly compact (compact) base. Finally, we prove that, in a reflexive Banach space, if the cone associated with an exact Banach frame is normal and generating, then X has an unconditional basis.

On Multi-objective Fractional Variational Problem Using Higher Order Efficiency

Bharti Sharma

bharti.sharma3135@yahoo.in
Department of Mathematics,
University of Delhi,
Delhi 110 007, India.

Multi-objective fractional variational problem has been explored in this article. Optimality conditions are established using efficiency of higher order as the optimality criteria. Parametric dual is proposed for which duality results are proved under the assumptions of $(F, \rho)-$invexity of higher order.

Sufficiency and Duality for a class of Interval-valued Programming Problem

Jyoti

deepshahjp@yahoo.co.in
Department of Mathematics,
University of Delhi,
Delhi 110 007, India.

This paper is devoted to study interval-valued optimizations problem. Sufficient optimality conditions are established for the stated problem under invexity assumptions. Weak, strong and strict converse duality theorems are derived for Wolfe and Mond-Weir type duals in order to relate the LU optimal solutions of primal and dual problems.

Pointwise well-posedness in set-valued optimization

Mansi Dhingra

mansidhingra7@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007, India.

In this paper we characterize some of the pointwise well-posedness notions available in literature for a set-valued optimization problem in terms of compactness or upper semicontinuity of appropriate minimal solution set maps. This leads to some of the characterizations which follow immediately from the characterizations of compactness of setvalued maps.

Shock wave structure in a viscous non-ideal gas under heat-conduction and radiation heat flux

Manoj Singh

smanojs2du@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007, India.

In present work, the structure of shock wave is investigated using the continuum hypothesis for one-dimension steady ow of a viscous non-ideal gas under the heat-conduction and radiation heat flux. The heat conduction and radiation heat flux have been taken as dependent on the temperature and density. Investigation for the possible solution of the governing non-linear equations have been done in term of singularity analysis, isoclines and integral curves. The thick- ness of shock transition zone has been calculated. The effect of non-idealness of the medium on the shock transition zone has been investigated. The variation of shock thickness on the non-idealness of the medium, Prandtl number, viscosity of the medium and initial Mach

number has been presented. It is found that non- idealness of the medium and variation of gas properties on the temperature has significant effect on the shock wave structure.

Directional convexity of harmonic mappings

Subzar Beig

beighsubzar@gmail.com
Department of Mathematics,
University of Delhi,
Delhi 110 007, India.

The convolution properties are discussed for the complex-valued harmonic functions in the unit disk $\mathbb{D}$ constructed from harmonic shearing of the analytic function $\phi(z) = \int_0^z (1/(1 - 2\xi e^{i\mu} \cos\mu + \xi^2 e^{2i\mu}))d\xi$ where μ and ν are real numbers.

Department of Mathematics

Faculty of Mathematical Sciences Building

University of Delhi, Delhi 110 007, India

Webpage: `http://maths.du.ac.in`

Phone: +91-11-27666658