

IWDIFFGEO 2015

The Department of Mathematics and Computer Science (DMACS), SSSIHL Prashanti Nilayam Campus, conducted a two-day international workshop titled **International Workshop on Differential Geometry - Foundations and Developments - IWDiffGeo 2015** from 10 to 11 July 2015, with the prime objective of

inspiring and motivating research in the domain of Differential Geometry. The workshop shed light on the foundations, current developments and future prospects in various branches of differential geometry and its applications in other branches of mathematics and physics through a series of expository and explanatory lectures delivered by renowned academicians.

### Day 1: 10 July 2015

#### SESSION 1

The workshop commenced with the ceremonial lighting of the lamp by the Honorable Chief Guest, **Prof. Ravi Kulkarni**, President, Ramanujan Math Society, and a rendition of invocatory Vedic chants by the students of the University.

The **Welcome Note** was delivered by **Prof. V. Chandrasekaran**, Head, Department of Mathematics and Computer Science. Being a Computer Scientist, he addressed the importance for a workshop on differential geometry in the context of computer science research, and the need for such workshops conducted by the University in promoting research among the scientific community of our country.

It was followed by an **Inaugural Address** by **Prof. Ramesh Sharma**, University of New Haven, USA, welcoming all the participants to the workshop. Pointing out that most talented math graduates pursue careers in computer science or business, the talk emphasized the opportunities for interaction between the eminent speakers and participants, presented by this workshop,

thereby acting as a booster for pursuing research in mathematics. Prof. Sharma noted that differential geometry has tremendous applications in various branches of mathematics such as control theory and branches of physics such as string theory and relativity and thus there is a need for promoting research in this domain.

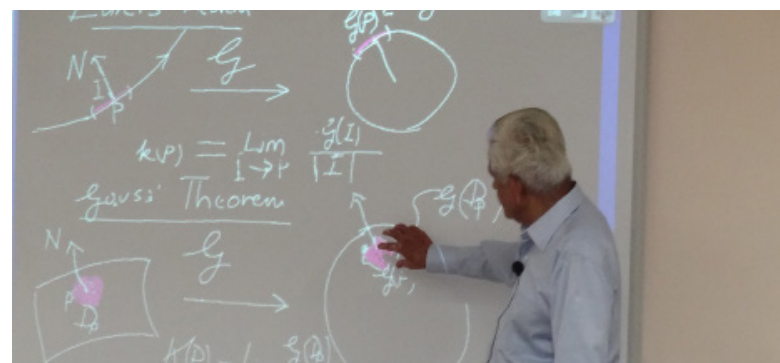
The **Keynote Address** was delivered by **Prof. Ravi Kulkarni**, President, Ramanujan Math Society, and it dealt with the broad area of **Sets and Curvature**. It began with Dedekind's famous essay, "What are, or what should be, the real numbers", that proved to be a starting point for the recognition of set theory as a new foundation for mathematics, and went on to explain how set theory provided a new ontology for mathematics, a mathematical expression of space, number and symmetry, and clarified the notion of infinity. The talk progressed to the concept of curvature, which is the foundation of differential geometry, arguing the manner of its definition and tracing its evolution through the times of Newton, Huygens, Euler, Gauss, Riemann, Cartan, and concluding with its use by Einstein in explaining the concepts of mass and gravity.

#### SESSION 2

The post-tea session consisted of a plenary talk by **Prof. G Santhanam**, IIT Kanpur on **Isoperimetric Upper Bound for the First Eigenvalue**. This scholarly talk focused on the estimates for bounds on the first eigenvalue of the Laplacian operator on various differentiable manifolds.

#### SESSION 3

The post lunch session began with a talk by **Prof. C S Arvinda** from TIFR Centre for Applicable Mathematics, Bangalore on the topic **Tiling, Polyhedrons, Euler Number and Gauss-Bonnet for Polyhedrons**. The talk took the audience through a journey into Graph Theory, starting from tilings of the Euclidean plane, moving on to Platonic and topologically regular solids, and concluding with the Gauss-Bonnet theorem for polyhedrons.





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After a short break for tea, a plenary talk was delivered by **Prof. Mukut Mani Tripathi**, Banaras Hindu University, Varanasi on the topic **Some Basic Inequalities for Algebraic Casorati Curvature and its Applications**.

After the conclusion of the first day of the workshop, a visit to the Sri Sathya Sai Institute of Higher Medical Sciences was organized for the participants.

## DAY 2: 11 July 2015

### SESSION 4

The Plenary Talk of the day was delivered by **Prof. Krishna Amur**, Karnataka University, on the topic **A Note on Invariant Objects under Lorentz Transformations**. The talk dealt with the derivation of expressions for the differential operators: gradient, divergence and curl, which are invariant under Lorentz transformation, using differential forms in an entirely new manner, so as to inspire investigation into the field of special relativity. Prof. Amur presented an ingenious idea of obtaining expressions for differential operators such as gradient, curl and divergence which are invariant under Lorentz transformation. Using these equations, he generalized classical Maxwell's electromagnetic equations from Newtonian space time to relativistic space time where time is not an absolute quantity. He also discussed some applications of minimal surfaces to polymer science with emphasis on 17 triply periodic minimal surfaces. The talk concluded with some remarks on conformal parameters and adjoint surface, followed by question and answer session.

The next speaker was **Dr. N Uday Kiran**, SSSIHL, who gave a brief introduction to the area of **Symplectic Geometry and its Applications** in the field of differential geometry. The talk began with a brief overview of symplectic vector spaces and manifolds, and probed its connection with the Hamiltonian formulations of classical mechanics, concluding with its applications to microlocal analysis that is widely used in the understanding of partial differential equations.

The post-tea session consisted of a panel discussion moderated

by **Mr. R Subrahmanian**, Brindavan Campus, SSSIHL, between all the invited eminent speakers and moderated by Mr. R Subramanian, Brindavan Campus, SSSIHL, on the topic **Research in Differential Geometry**. Each of the speakers described how they got into research in the domain of differential geometry, in general, and the various topics they presented, in particular. The speakers threw in interesting anecdotes from their lives, and explored the importance of mathematics for research in every field of science. The interactive session concluded with a brief discussion on the Integral Education system and its efficacy in their all-round students's growth of SSSIHL.

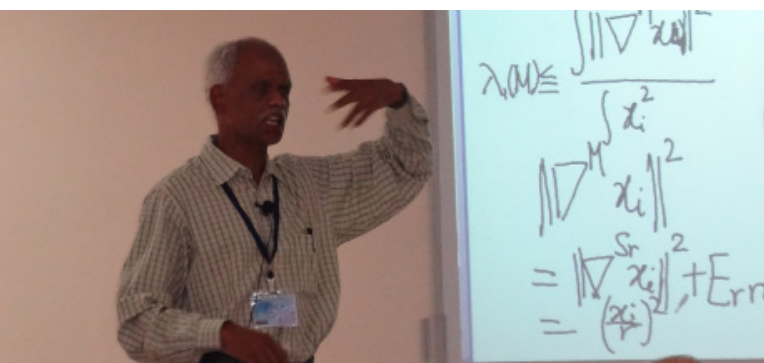
### SESSION 5

After a break for lunch, all the participants and invited speakers made a visit to Sri Sathya Sai Space Theatre, where they were treated to a half-an-hour show on the origins and mysteries of the universe.

The first talk of this session was a **Plenary Talk**, delivered by **Prof. Ramesh Sharma** on the topic, **Ricci Solitons – Foundations and Development**. Prof. Sharma began with a review of Riemannian geometry and Hamilton's Ricci flow, explaining its self-similar solution called Ricci soliton. After presenting a few examples and important results, mainly on rigid Ricci flows and gradient shrinking solitons, and their relationship with Perelman's entropy functional, Prof. Sharma concluded with results on Ricci Solitons as special Riemannian metrics and some open problems that can be investigated.

A **Valedictory Talk and Vote of Thanks** by **Dr. N Uday Kiran** brought the workshop to a close.

The organizers of IWDiffGeo-2015 offer the workshop at Bhagawan's lotus feet as a humble effort in promoting His vision of raising the levels of research at SSSIHL, and express their gratitude to Him for guiding the workshop from its conception to its successful completion.





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### LIST OF SPEAKERS

- » Prof. Ravi Kulkarni, President, Ramanujan Math Society, Pune
- » Prof. Krishna Amur, Professor Emeritus and Head of the Department of Mathematics, Karnatak University, Dharwar.
- » Prof. Ramesh Sharma, Department of Mathematics, University of New Haven, Connecticut, USA
- » Prof. G Santhanam, Department of Mathematics and Statistics, IIT Kanpur
- » Prof. Mukut Mani Tripathi, Department of Mathematics, Banaras Hindu University, Varanasi
- » Prof. C S Arvinda, TIFR-CAM, Bangalore
- » Dr. N Uday Kiran, Department of Mathematics and Computer Science, SSSIHL

### RESUME OF SPEAKERS

**Prof. Ravi Kulkarni** obtained his Ph.D from Harvard University in 1967. His career in academia spans over four decades, including positions such as Distinguished Professor in Mathematics, IIT (Bombay), Sept 2006 - April 2013, Distinguished Professor and Director, Harish-Chandra Research Institute, Aug 2001 - July 2006, Professor of Math, City University of New York, 1985-2008 and Professor of Math, Indiana University, Bloomington, Indiana, 1977-1985. He has held editorial positions in various internationally renowned journals, such as Ramanujan Math Society Lecture Notes Series (2005-2013), and Journal of the Ramanujan Math Society (2005-Present). He also served in the NBHM-sponsored Committee which started Advanced Training in Mathematics between 2005 and 2013. He is currently President, Ramanujan Math Society, Pune and Convenor, Regional Programs of the Ramanujan Math Society, as part of which, 30 Undergraduate Teachers Enrichment Programs have been conducted. His research interests include differential geometry, discontinuous groups, hyperbolic geometry, number theory, algebra and graph theory. He has over 80 research publications to his credit, and has guided 8 Ph.D students so far, with 2 students currently pursuing Ph.D under his guidance.

**Prof. G. Santhanam** has been in the Department of Mathematics and Statistics, IIT Kanpur since December 1998. He did his M.Sc. from Madurai Kamaraj University, Madurai in the year 1985, following which, he joined TIFR in August 1985, working in the area of differential geometry under the guidance of Prof. Akhil Ranjan from IIT Bombay. His research interest lies in the area of Geometric Analysis in general, and "Geometry of Eigenvalues of Laplace Operator", in particular. He has 14 research papers and 1 book to his credit. He has also been associated with the "Mathematics Training and Talent Search Programme" since its inception in 1993.

**Prof. C S Arvinda** completed his B.Sc. And M.Sc. In Mathematics from the Central College, Bangalore between 1980 and 1985. He went on to finish his Ph.D from TIFR Mumbai under the guidance of Prof. S. G. Dani in the year 1995. Following that, he held various academic positions in nationally renowned colleges like ISI, Bangalore, Chennai Mathematical Institute, Chennai, and is currently Associate Professor, TIFR Centre for Applicable Mathematics, Bangalore. His research interests lie in the study of manifolds of nonpositive curvature, with special focus on their dynamic, geometric and topological aspects. He has lectured extensively in workshops and conferences both in India and abroad, both at an expository and research level, and has also been a part of organizing several workshops in Geometry and Ergodic Theory. He is also involved in various outreach efforts such as Mathematics of Planet Earth 2013, an interactive exhibition explaining mathematical ideas, and simplifying significant mathematical developments for a wide audience through his Kannada writing. He has held positions on the editorial boards of various conferences and journals such as Hardy-Ramanujan Journal and the Mathematics Student.

**Prof. Mukut Mani Tripathi** completed his M.Sc. in Mathematics from University of Lucknow in the year 1986, and went on to pursue his Ph.D from the same university after obtaining CSIR-UGC Junior Research Fellowship in 1988. He has been a professor of Mathematics in Banaras Hindu University since November 2007. He has certificates of proficiency in French and Russian languages apart from a Diploma in Russian. He won the A.M.U. Prize of the Indian Mathematical Society at its 59th Annual Conference in 1993. He has supervised 4 Ph.D theses so far and has over 50 publications to his credit, with 27 foreign co-authors. He is a member of many distinguished academic bodies such as the American Mathematical Society, Indian Mathematical Society, Indian Science Congress Association, National Academy of Sciences India, Balkan Society of Geometers and International Electronic Journal of Geometry. His research interests include structures on manifolds, submanifolds and submersions.

**Prof. Krishna Amur**, a Professor Emeritus of Mathematics in Differential Geometry is head of the Department of Mathematics, Karnatak University, Dharwar. Prof. Amur is the founder member of the Sri Aurobindo Society in Dharwar (1992) of Karanataka State and the vice-president of Karnatak Education Board, Dharwar. Prof. Amur is the younger brother of Sri G. S. Amur, a leading contemporary writer and critic in Kannada and English. Born in 1931 and raised in Suranagi village of Haveri taluka, he earned a M.Sc. and a Ph.D (1964) in Mathematics from the Karnataka University, Dharwar. From 1960 to 1962, he was a lecturer of Mathematics at the Karnataka College, Dharwar and then a Professor of Mathematics at the Department of Mathematics, Karnatak University, Dharwar. Prof. Amur was a postdoctoral fellow at the Department of Mathematics, University of North Carolina at Chapel Hill, from 1967 to 1968 and again in 1984, he came to the USA on a fellowship program for a year. He was also acting registrar of the Karnataka University, Dharwar from 1978-80.





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## Department of MATHEMATICS & COMPUTER SCIENCE

### International Workshop on Differential Geometry - Foundations and Developments (IWDiffGeo 2015)

10-11 JULY 2015 @ PRASANTHI NILAYAM CAMPUS

**Prof. Ramesh Sharma** is a Professor in the Department of Mathematics, University of New Haven, West Haven, Connecticut, USA. He completed his B.S.(Hons) and M.S. from the Banaras Hindu University before completing his Ph.D on the topic, "Differentiable Manifolds with Polynomial Structures" in the year 1980. He then went on to complete a second Ph.D from the University of Windsor, Ontario, Canada, on the topic, "Cauchy-Riemann Submanifolds of Semi-Riemannian Manifolds with Application to Relativity and Hydrodynamics", in the year 1986. Since then, he has been in the Department of Mathematics, University of New Haven, becoming a Professor in September 1997. He is a visiting Professor at a number of universities, including Michigan State University, Michigan, and SSSIHL. He has won a number of awards and honors, including being selected for Who's Who Among America's Teachers, 2006, Fulbright Lecturing Grant (India), 2005, and Excellence in Research/Creative Activity Award, University of New Haven, 2008. He has over 75 papers in peer-reviewed national and international journals and presented over 40 papers in conferences worldwide and is a member of a number of organizations such as International Society of General Relativity and Gravitation (Switzerland) and the American Mathematical Society. He has also been on the review board of a number of journals such as Journal of Mathematical Physics and Proceedings of the American Mathematical Society. He has been an advisor to a number of Ph.D and Masters students that have led to publications in prestigious journals worldwide such as International Journal of Pure and Applied Mathematics and International Journal of Mathematical Education in Science and Technology.

**Dr. N Uday Kiran** is an Assistant Professor in the Department of Mathematics and Computer Science, Sri Sathya Sai Institute of Higher Learning. He completed his B.Sc., M.Sc. And M.Tech in Computer Science from SSSIHL before pursuing his Ph.D in the area of Microlocal Analysis under the supervision of Dr. B. R. Nagaraj from TIFR-CAM. He achieved an All India Rank of 51 in GATE Mathematics 2003 before obtaining Junior Research Fellowship through the CSIR-UGC NET examination in 2005. His areas of research include Microlocal Analysis, Symplectic Geometry, Algebraic Analysis, and Mathematical techniques for Image Processing. He has 5 publications in international journals to his credit apart from a number of conference and workshop presentations. He has also collaborated with the Dipartimento di Matematica, University of Torino, on the project "Global Well Posedness and Decay Problems of SG-Hyperbolic Operators".

