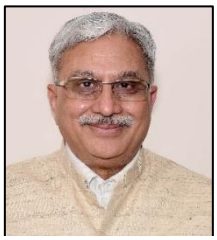
Sectional Committee -IV
Earth & Environmental Sciences

Chair
Prof G. Parthasarathy, FNA

Professor G Parthasarathy FNA is currently a DAE-Raja Ramanna Chair Professor at DAE-Atomic Minerals Directorate for Exploration and Research, Sothern Region, Bengaluru. He obtained his PhD in 1984 from IISc Bangalore, AvH fellow 1987-88, and worked for CSIR-NGRI from 1990-2018. He joined as an Adjunct Professor and INSA Senior Scientist at National Institute of Advanced Studies, Bengaluru (2019-2024) in Earth and Planetary Sciences. He was a President of Indian Social Science Academy (Allahabad) during 2021-22. He has published about 330 research papers in peer reviewed journals, in the area of Condensed Matter Physics, and Materials Science, Earth and Planetary sciences

INSA Distinguished Lecture

Earth System Science: The Science of Sustainability



Shailesh Nayak

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Sustainability to be approached at three levels of 'system' – global, social and human (Komiyama and Takeuchi, 2006). The Global or earth system comprises the planet Earth and its components – the geosphere, atmosphere, hydrosphere, cryosphere and biosphere. The earth sustains human being by providing natural resources, energy and conducive ecosystem to survive and Earth system science provides a physical basis for understanding the world in which we live and upon which sustainability depends. The social system consists of the political, economic and industrial structures created by human beings to provide a societal base for the human existence. The human system is connected to the social system and requires following certain lifestyles and values for well-being of people.

In broad sense, the earth system science brings together, geo- and ecosystem sciences, space science and applications, technology, engineering along with social science, economics and cognition. Remote sensing provides information about components of the Earth system and facilitates the understanding about interactions between these components and anthropogenic activities. The changing global and regional climate and their impact on components of earth systems is critical for sustainability. Some of the aspects discussed include water resources, both surface and ground water, their storage and recharge; snow and glaciers and mass balance; agro-ecosystems (landscapes and soils) and their management; Response of marine ecosystems and fisheries to climate Change, hazards, prediction and warning systems, increased demand of critical minerals and rare earths. The interaction of ecological, economic and social processes and their understanding and modelling are basis for the sustainable development.

Speaker's Profile

Dr. Shailesh Nayak is Director, National Institute of Advanced Studies, Bengaluru and Editor-in-Chief, Journal of the Indian Society of Remote Sensing, Dehradun. He was Secretary, Ministry of Earth Sciences, during 2007-2015 and provided leadership for programs related to earth system sciences. His current research interest includes building strategy for blue economy and sustainable development. While at the Space Applications Centre, ISRO, he pioneered the development of algorithms for the application of remote sensing to the coastal and marine environment, and generated baseline database of the Indian coast, and developed services for fishery and ocean state forecast. He had set up a state-of-the-art Early Warning System for Tsunami at the Indian National Centre for Ocean Information Services (INCOIS), Hyderabad.

Dr Nayak is a Fellow of the Indian National Academy of Science, Delhi, Indian Academy of Sciences, Bengaluru, National Academy of Sciences, India, Prayagraj, International Society of Photogrammetry & Remote Sensing (ISPRS), Academician of the International Academy of Astronautics (IAA). He has published about 200 papers in peer-reviewed journals.

The Govt of India awarded the 'Padma Shri' in the field on science and engineering in 2024.

INSA Distinguished Lecture

Structure and Evolution of the Indian Continental Lithosphere

Supriyo Mitra

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The Indian Lithosphere has been shaped by multiple tectonic processes, which include break-up from the Gondwana Supercontinent, traversing over the Reunion and Kerguelen hotspots, collision with Eurasia, and underthrusting beneath the Himalaya and Tibetan Plateau. Seismic velocity structure and radial anisotropy of the lithosphere preserves imprints of these tectonic processes and related deformation. We perform joint-modeling of fundamental-mode Rayleigh (LR) and Love (LQ) wave group-velocity dispersion, for periods between 10 and 120s, to obtain radially anisotropic shear-wave velocity structure across India, Himalaya and Tibet. 1D path-average dispersion curves, computed for ~14700 regional earthquake-receiver raypaths, has been passed through systematic quality control of signal-to-noise ratio (>3), elimination of multipathed energy using polarization analysis, and removal of overtone interference, by synthetic tests. These 1D dispersion data are combined through a tomographic formulation to obtain 2D maps. LR and LQ fundamental-mode group-velocity dispersion data at 4906 tomographic nodes are jointly inverted for an anisotropic Vs structure. Results are presented as 2D depth-slice maps and cross-sections constructed using bilinear interpolation. The main findings from our models provide: (i) a characteristic voigt-average Vs structure and radial anisotropy of the Indian continental lithosphere, structure of the sedimentary basins, and the geometry of the Moho; (ii) the disposition of the Indian Plate beneath Himalaya-Tibet, its lateral variations and internal structure; and (iii) the signatures of plume-lithosphere interactions, mainly between the Reunion hotspot and the Indian lithosphere.

Speaker's Profile

Supriyo Mitra is a seismologist interested in earthquake source physics, internal structure of the Earth, attenuation characteristics of seismic waves and simulation of earthquake ground motion. He obtained his PhD from the University of Cambridge, UK and is a Professor in the Department of Earth Sciences, IISER Kolkata. He pioneered broadband-seismological-field experiments in the Himalayas, and studies velocity structure and earthquake source properties, to test hypotheses of lithospheric evolution. He is a recipient of the INSA Young Scientist medal, NASI-Scopus Young Scientist Award, National Geoscience Award, Cambridge-Hamied Fellowship, INSA Associate Fellowship and Associateship of the International Center for Theoretical Physics, Trieste.

INSA New Fellow Lecture

Unravelling the crustal architecture and basin evolution of the eastern Indian continental margin using the constrained potential field modelling

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The crust underlying the Eastern Continental Margin of India preserves the imprints of the rift-drift episodes associated with the eastern Gondwana breakup and resulted complex crustal architecture and the development of several major sedimentary basins. Due to lack of identifiable magnetic anomalies, the location of continent-ocean boundary, nature of rifting and subsequent breakup along the margin remain poorly constrained. This knowledge gap hinder our understanding of the pre-rift configuration of India within the East Gondwana. I present here, the results from seismically constrained potential field and process-oriented gravity modelling of the margin which revealed the crustal architecture across different segments of the margin. In the southern and central conjugate segments, magma-poor margin characteristics are evident, with exposed mantle and hyperextension primarily found in the Krishna-Godavari basin of the Indian margin. Conversely, the northern conjugate segments display thick magmatic underplating at the Ocean-Continent-Transition zone indicating magma-rich margin characteristics. Further, the tight-fit reconstruction model, developed based on palinspastically restored conjugate margins and available geological constraints, suggests that the central part of the East Indian margin (16°-20°) is the ideal pre-rift location for the Elan Bank.

Speaker's Profile

Dr. Munukutla Radhakrishna is Professor and Head, Department of Earth Sciences, IIT Bombay. He is teaching geophysics for the last 32 years, guided 25 Ph.D students and published 76 research papers. His research interest includes multi-scale potential field modelling to delineate the crustal structure, rheology, basin formation along Indian continental margins and contiguous regions. Dr.Radhakrishna is the recipient of numerous awards and recognitions which include the Krishnan Medal and Decennial awards of the Indian Geophysical Union, National Geoscience Award, the S.P Sukhatme Award of Excellence in Teaching by IIT Bombay and the UGC Commonwealth Academic Staff fellowship.

INSA New Fellow Lecture

River Futures in the Anthropocene: Integrating geospatial intelligence and policy interventions for sustainable river management

Rajiv Sinha
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The term 'Anthropocene' refers to the recent period of Earth's history when human activities started to produce perceptible impacts on Earth's ecosystems. Rivers, particularly large river systems, constitute one of the most fundamental life-support systems that have sustained civilisations, and are projected to be a critical determinant for the future sustenance of human civilisations. In a world that is expected to witness a near doubling of the human population by the middle of the century, and a world that is likely to be impacted by an unprecedented rate of global change, one of the main sustainability agendas will be the construction of dynamic strategies for the management of natural freshwater systems. For more than 5000 years, civilisations have flourished in the South Asian region, leading up to a population hotspot that hosts almost a fifth of the globe's human population. In turn, this has led to significant human intervention and impacts on the freshwater systems of the region. Therefore, the understanding of water problems and water security in this region has to be embedded in holistic approaches that stress the interrelationships of earth, water, and humans. As large river systems constitute a lifeline for the future of human populations, it is important to understand them to secure their futures and thereby our futures. In India, human activities, such as structural interventions, land-use/land-cover changes, sand mining, excessive groundwater usage leading to land subsidence, encroachment of flow pathways ('river space'), and enhanced soil erosion, have significantly altered the hydrological regime of rivers and the associated landscape. This presentation will document the major impacts of human-induced changes on the riverscape using case studies from different parts of the country on problems related to hydrological flow modification, sediment dynamics, flood risk and river health degradation. The focus will be on the use of modern technologies such as geospatial intelligence and hydrological modelling to assess and mitigate these impacts from a sustainability perspective. One of the major problems in such assessments is the lack of "reference conditions" for many Indian rivers, given their long histories of human disturbance. Addressing this complexity requires a river science-based management approach—drawing upon hydrology, geology, chemistry, and ecology—to understand how these processes interact and shape river form and function and eventually river health. Incorporating hydrogeomorphic parameters into river health assessments and rehabilitation strategies is crucial, as is transitioning from "command and control" to an ecosystem-based management paradigm. This shift is essential for supporting more resilient and sustainable river futures in the Anthropocene. It is important to reshape our river management strategies with a perspective of 'River Futures', which advocates an integrated, scientific, and landscape-based approach that goes beyond traditional engineering solutions and fragmented management. This approach emphasises the inherent diversity and dynamic nature of rivers, the historical and ongoing impacts of human activity, and the necessity for integrating social, ecological, and geomorphic perspectives in river management. In essence, it envisions a new era for river management where science, practice, and society intersect to produce resilient, functional, and valued rivers—providing a practical roadmap and stressing a paradigm shift in the mindset of river managers and policy makers.

Speaker's Profile

Rajiv Sinha is a river scientist who has worked on the fundamental hydrological processes in large rivers to understand their geomorphic diversity and complexity as a function of hinterland characteristics, river form and climatic regime. Some of his noted works on flood risk assessment, river dynamics, environmental flows assessment and sediment management of the Indian rivers are being used for developing river management strategies by the stakeholders. One of his most significant research includes geomorphic and stratigraphic characterisation of paleochannels in northwest India linked to the evolution of the Harappan civilisation in this region.

INSA New Fellow Lecture

The axial dipole field and its polarity transitions in Earth

Binod Sreenivasan

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The Earth's dynamo is driven by convection in the planet's fluid outer core. Our recent studies indicate that the preference for the axial dipole in Earth-like planets is due to a magnetohydrodynamic process influenced by both rotation and the self-generated magnetic field. We focus on the role of slow magnetostrophic waves, which are produced from localized balances between the Lorentz, Coriolis and buoyancy (MAC) forces in the core. While these waves are essential for dipole formation, the suppression of these waves under strong forcing results in magnetic polarity transitions, including reversals. Since convection in the core of Earth is thought to be influenced by lateral variations in heat flux in the lowermost mantle, the above ideas may be extended to core convection by decomposing buoyancy into its vertical (radial) and horizontal (lateral) parts. In the unstably stratified fluid layer, polarity transitions are induced by an equatorially anti-symmetric heat flux pattern at the outer boundary. The fact that compositional buoyancy is much stronger than thermal buoyancy in the core, together with the known order of magnitude of the peak field intensity, indicates that the core can operate under a large lower-mantle heat flux heterogeneity, of $O(10)$ times the mean heat flux at the core-mantle boundary.

Speaker's Profile

Binod Sreenivasan is a Professor of Earth Sciences at IISc, Bangalore. He earned his B.Tech (Honours) from NIT Calicut, M.S. from IIT Madras, and Ph.D. from the University of Cambridge. Prior to his current role, he served as a Scientist at ISRO and held postdoctoral positions in France and the UK, including a Leverhulme Research Fellowship. His research expertise lies in planetary magnetism, dynamo theory and geophysical fluid dynamics. A recipient of the SwarnaJayanti Fellowship (2011) and the Doornbos Memorial Prize (2014), he was elected a Fellow of the Indian Academy of Sciences in 2020.

INSA Associate Fellow Lecture

Assimilation of Indian satellite observations in the regional atmospheric model

Prashant Kumar
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The evolution of numerical weather prediction (NWP) has been strongly driven by advances in observational capabilities and data assimilation methodologies. Although ground-based measurements remain valuable, satellite observations now supply nearly 90–95% of the data assimilated into operational models, greatly improving spatial and temporal coverage. However, only a limited fraction of satellite-derived information is effectively utilized.
In current practice, most infrared radiances are assimilated only under clear-sky conditions, as cloud-affected radiances require complex cloud screening or correction procedures. This restriction is not due to the lesser importance of cloudy-sky observations, but rather to challenges in radiative transfer modelling, inaccuracies in first-guess cloud parameters, and difficulties in defining appropriate error statistics. Additionally, the nonlinear behaviour of cloud formation and evolution further complicates the assimilation of cloud-contaminated IR radiances.

Significant efforts have been made to advance all-sky radiance assimilation. In particular, assimilation of INSAT-3D/3DR water vapour channels have attempted to incorporate cloudy-sky radiance to improve monsoon prediction. These investigations have also highlighted the importance of including multivariate background-error correlations to better represent the coupling between hydrometeors and dynamical variables under cloudy conditions. Furthermore, a nonlinear filtering approach has been implemented to assimilate INSAT-3D all-sky window-channel radiances into the WRF model using a particle filter technique, demonstrating the potential of advanced assimilation frameworks for improving weather forecasting.

Speaker's Profile

Prashant Kumar earned his Ph.D. in Applied Mathematics from MNNIT Allahabad and has been a Scientist at ISRO's Space Applications Centre since 2008. His primary research interests lie in satellite data assimilation in numerical weather prediction. He has published 112 papers in international peer-reviewed journals. Dr. Kumar has received several prestigious honours, including the NASA Team Award, ISRO Team Award (twice), the Young Researcher Award from the Ministry of Earth Sciences, the Indian Meteorological Society Award, and the P. R. Pisharoty Award, Vigyan Yuva Shanti Swarup Bhatnagar Award.

INSA Young Associates Lecture

Hydroclimatic Variability and Vegetation Response over the Last Four Millennia: Multiproxy Records from Majuli Island (World's Largest River Island), Northeast India

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This study integrates biotic (pollen) and abiotic (granulometric) proxies from a 150 cm deep sediment profile of an endangered wetland on Majuli Island, Assam, within the Indo-Burma biodiversity hotspot and under the influence of the Indian Summer Monsoon (ISM). Pollen analysis, supported by modern analogues from 25 surface samples, enabled reconstruction of Mean Annual Temperature (MAT) and Mean Annual Precipitation (MAP) across five pollen zones (SW-I to SW-V) using the Coexistence Approach (CA). The earliest phase (SW-I; 2090–310 BCE / 4040–2260 cal. yrs. BP) indicates warm, humid conditions (MAT ≈ 30 °C; MAP ≈ 3000 mm) with dense forest cover, suggesting regional climatic resilience during the globally arid 4.2 ka event. The presence of *Rhododendron* and *Castanopsis* points to episodic flooding under unstable conditions. Between 310 BCE and 490 CE (SW-II; 2260–1460 cal. yrs. BP), vegetation became more open and relatively less humid with reduced flood activity. A subsequent increased moist interval (850–1450 CE; SW-IV; 1100–500 cal. yrs. BP) corresponds to the Medieval Climatic Anomaly (MCA), marked by renewed deciduous forests and elevated MAP (~2750 mm). Post-1450 CE (SW-V; 500 cal. yrs. BP), declining MAT (13–22 °C) and MAP (500–1092 mm) indicate relatively less humid climate, in consonance to Little Ice Age cool and enhanced human impact, evident by anthropic pollen and savanna-like vegetation. Granulometric shifts reveal transitions from low- to high-energy fluvial regimes through time. Overall, the record highlights regional variability in Holocene monsoon responses and underscores the importance of Majuli's depositional archives for assessing the resilience and sensitivity of tropical systems to past and future abrupt climate change.

Speaker's Profile

Dr. Swati Tripathi is a Scientist-E in the Quaternary Palaeoclimate Laboratory at the Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow. Her research specializes in reconstructing Quaternary vegetation, climate, and depositional environments using diverse biotic and abiotic proxies. She has notable expertise in pollen micro-morphometry, copropalynology, and melissopalynology. Dr. Tripathi received her Ph.D. (2011) and M.Sc. in Botany (2007) from Lucknow University, where she was awarded three gold medals, including the prestigious Birbal Sahni Memorial Gold Medal. Her scientific contributions have been recognized through several honors, including the Dr. B.S. Venkatachala Memorial Medal (2012), Dr. Chunni Lal Khatiyal Medal (2016), SERB Women Excellence Award (2019), and selection as an IAS Young Associate (2017–2021). Most recently, she has been elected as an Associate of the Indian National Science Academy (INSA) and has been awarded the Mani Shankar Shukla Gold Medal (2025) by the Palaeontological Society of India. She has published 62 research papers, supervised 16 M.Sc. dissertations, one awarded Ph.D., and currently mentors two doctoral scholars. Dr. Tripathi's research significantly contributes to major palaeoecological and palaeoclimatic projects across Northeast India and the Ganga Plain.

INSA Young Associates Lecture

Reconstructing Precambrian magmatic histories of the Indian Shield: From dyke swarms to LIPs

Amiya K. Samal

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The diverse crustal features of the Indian Shield reflect a long and complex history of geological processes, among which magmatism has played a pivotal role in modifying the crust and lithosphere through time. The Indian Shield preserves one of the most extensive and diverse archives of Precambrian magmatism on Earth. Beyond its well-documented volcanic and plutonic records, the shield hosts several Archean and Proterozoic Large Igneous Provinces (LIPs)—vast, short-lived (<5 Myr) episodes of mantle-derived magmatism emplaced on a continental scale. These LIPs are expressed through diverse plumbing system components, including mafic dyke swarms, sill complexes, and layered intrusions, which together constitute key lithological units across different cratonic blocks. An integrated approach combining field relationships, dyke geometry, geochemical and isotopic systematics, and high-precision U–Pb geochronology has enabled the recognition of major Precambrian magmatic events across the Indian Shield. Collectively, the record reveals three Archean and thirteen Proterozoic LIPs, manifested as two Archean and twenty-three Proterozoic mafic dyke swarms, four Proterozoic sill complexes, four Archean tholeiite–komatiite associations, and five kimberlite–lamproite–alkaline–carbonatite suites, supplemented by minor felsic dyke intrusions. Together, these magmatic systems delineate a long-lived history of several plume-driven magmatism, reflecting cycles of lithospheric growth, and reactivation linked to evolving mantle dynamics and supercontinent assembly processes during the Precambrian.

Speaker's Profile

Dr. Amiya Kumar Samal is an Assistant Professor in the Department of Geology, Banaras Hindu University, since 2017. His research specializes in igneous petrology and geochemistry, focusing on the subcontinental lithospheric mantle beneath Archean cratons of the Indian Shield. He has extensively investigated Paleoproterozoic mafic dyke swarms to unravel mantle evolution and identify Precambrian Large Igneous Provinces (LIPs) through geochemical, isotopic, and U–Pb geochronological studies. Dr. Samal has published 35 research papers and received the Associate of IASc, NASI Young Scientist Award, and National Young Geoscientist Award, Ministry of Mines, Govt. of India.

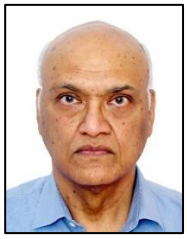
Sectional Committee -IX
Health Sciences

Chair
Prof. Shally Awasthi, FNA

Prof Shally Awasthi is a Paediatrician and epidemiologist. She is former Dean R and D, Head of Department of Pediatrics King George's Medical University Lucknow. Her name has been included in the top 2% scientists in the Stanford list for the last 6 years. Her areas of research interest are paediatric pulmonology(childhood pneumonia), geohelminthic infestations, micronutrient deficiencies and lead toxicity.

INSA Distinguished Lecture

Using modelling to make medical decisions



Rakesh Aggarwal

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Mathematical modelling of disease uses mathematical equations to represent disease transmission, progression and outcomes, and helps inform public health policies by forecasting changes in disease burden over time, assessing the impact of various public health interventions, such as contact tracing, vaccination programs, and drug treatment, and comparing their cost-effectiveness and budget impact. This technique permits a rapid comparison of various interventions, whereas clinical trials to compare these often take years, delaying introduction of useful healthcare interventions, are costly, and may be unethical or impossible. In early 2000s, we used modelling techniques to show that universal newborn hepatitis B vaccination in India would be highly cost-effective, and preferable to the then proposed strategy of vaccinating only children born to hepatitis B infected mothers. In fact, we showed that universal vaccination was cost-saving if healthcare costs of cirrhosis and liver cancer were also factored in. These findings played a role in the introduction of universal hepatitis B vaccination in the country, with a consequent major reduction in liver disease burden.

During the 2010s, when generic direct-acting anti-viral agents (DAAs) against hepatitis C virus (HCC) became available in India, our modelling analysis showed that treatment of HCV with these drugs would be cost-saving, and that these savings would be achieved within a few years. Based on these, HCV treatment guidelines for India's National Viral Hepatitis Control Programme and the World Health Organization adopted a universal HCV treatment policy. Further analysis helped determine a price point at which velpatasvir, a newer but costlier DAA whose use did not need viral genotype testing, would be price-neutral with the DAAs that were already available, leading to a reduction in its price. The consequent simplification of HCV treatment has helped a more widespread adoption of HCC treatment in the country, benefitting several HCV-infected people.

Using the above examples, the talk will argue for a greater use of mathematical modelling techniques in health policy decisions.

Speaker's Profile

Professor Rakesh Aggarwal is a hepatologist, with training also in epidemiology and laboratory sciences. He has been working in the field of viral hepatitis, including on clinical, epidemiologic, laboratory, public health and preventive aspects of this disease for over three decades. He is also active in the field of vaccine science. He has contributed to public policy in the field of liver disease and immunization at both national and international level, having served on several committees and expert groups of the Government of India and the World Health Organization.

INSA Distinguished Lecture

Kawasaki disease in India: Epidemiology, cardiovascular outcomes and public health implications

Rakesh Kumar Pilania

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Kawasaki disease (KD), an acute childhood vasculitis, has emerged as the leading cause of acquired heart disease in children worldwide, surpassing rheumatic heart disease. Research from India has made significant contributions to understanding the epidemiology, cardiovascular manifestations, and immunopathogenesis of KD. Through hospital-based analyses, we demonstrated a rise in KD incidence in Chandigarh over the years, emphasising its growing public health burden. Using coronary CT angiography, we characterised distal and left circumflex coronary artery abnormalities, reshaping the understanding of long-term cardiac outcomes in KD. Our studies have also elucidated macrophage activation syndrome as a serious complication of KD, explored genetic and immunopathogenic pathways, and identified potential biomarker genes through integrative genomic approaches. Investigations into treatment intensification and IVIG resistance mechanisms have informed clinical management strategies tailored for resource-limited settings. Despite advances, underdiagnosis remains a particular concern. Predictive modelling projects an increase in disease burden, necessitating improvements in surveillance, awareness, and equitable access to treatment. KD in India is transitioning from a rare condition to a significant pediatric cardiovascular health challenge. Establishing a national KD registry, expanding clinician training, and integrating molecular research into clinical practice are crucial to reducing long-term coronary morbidity and mitigating the future public health burden of KD in India.

Speaker's Profile

Dr. Rakesh Kumar Pilania is Associate Professor at the Pediatric Allergy Immunology Unit, Advanced Pediatrics Centre, PGIMER, Chandigarh, India—accredited as both a WHO Collaborating Centre (2022–2026) and an APLAR Centre of Excellence for work in Kawasaki disease (KD). His research focuses on the epidemiology, genetics, and outcomes of KD, supported by several extramural grants (ICMR, DBT, DST, APLAR) and over 182 publications, including 60 on KD. He has received several prestigious national and international awards, including the IRA Young Rheumatologist Oration (2024), Early Career Investigator Highlight Award and Science Digest Award at the International KD Symposium (2024), Young Investigator Award from APSID (2024), APLAR Research Award (2022), and Associate Fellowship of INSA (2023). Dr. Pilania has also received the Dr. Balagopal Raju Endowment Award (2022) and Dr. James Flett Endowment Award (2024). He recently conducted the GIAN Program (2025) on KD and currently serves as Secretary, Indian Society of Kawasaki Disease.

INSA Foreign Fellow Lecture

Immunotherapeutic Approaches Against Acinetobacter baumannii

Bernard P Arulanandam

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The ESKAPE pathogen Acinetobacter baumannii (Ab) has become a critical hospital-acquired pathogen due to its widespread multi-drug resistance (MDR) ability and is associated with bacteremia leading to sepsis. Considering the rapid disease progression of Ab infection along with no available licensed vaccine, monoclonal antibody (mAb) therapy has great potential as a modality of life-saving treatment for Ab. Employing an immunoinformatics AI-based approach, our laboratory created a novel multipeptide vaccine (AMEV2) for protection against major lineages of Ab containing 5 major peptides from proteins associated with Ab pathogenesis (displaying putative B- and T-cell epitopes). Through rigorous in vitro and in vivo studies, we have shown that the protection afforded by the AMEV2 vaccine is antibody-based, acting through opsonophagocytic killing. AMEV2-vaccinated mice that were protected from A. baumannii challenge had significantly more pTonB-specific antibodies compared to those that were unprotected. Moreover, pTonB-depleted antibodies exhibited significantly reduced opsonophagocytic killing of A. baumannii. These combined in vivo and in vitro data indicate that pTonB peptides contain epitopes (involved in iron acquisition systems) that have therapeutic potential against drug-resistant Acinetobacter. We have now developed anti-Ab pTonB mAbs using hybridoma technology and are currently characterizing the role of antibody-mediated immunity of the pTonB mAb and its associated transporter, focusing on opsonophagocytic activity, metabolism, and iron transport. These studies will lead to further insight(s) on the use of the pTonB mAb alone or in combination with a vaccine as an effective therapy for Ab infection.

Speaker's Profile

Professor Bernard Arulanandam is the Vice Provost for Research at Tufts University. As an established Immunologist, Dr. Arulanandam holds an appointment as Professor at the Tufts University School of Medicine. His research focuses on elucidating host-microbial interactions and the cellular and molecular mechanisms involved in the induction of immune responses against infectious diseases. Dr. Arulanandam is a fellow of the American Association for the Advancement of Science and an elected fellow of the American Academy of Microbiology and the US National Academy of Inventors.

INSA New Fellow Lecture

Understanding the role and regulation of human plasmacytoid dendritic Cells

Dipyaman Ganguly

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Our research in human immunology and cell biology focused on a particular innate immune cell subset called the plasmacytoid dendritic cells (pDC) for past two decades. PDCs are professional type I interferon producing cells in the body, driven by endosomal toll-like receptor activation in response to nucleic acid ligands of both pathogen and host origin. Accordingly, pDC function is crucial in the context of infectious as well as autoimmune diseases. On the other hand, dysregulation of pDC function is a major hindrance to effective anti-cancer immunity. Apart from discovering crucial role of pDCs in the contexts of autoimmune diseases like systemic lupus and psoriasis, our laboratory in India was the first to show a crucial role of these cells in obesity associated metabolic disorders. We also explored the regulatory pathways in human pDCs and identified crucial role of several novel modules that control human pDC functions and can be targeted for therapy, viz. a rheostat involving endocannabinoid receptors and hydrolases, inhibitory role of lactate receptor signaling, regulation of endolysosomal pH by a polyamine transporter as well as a chloride-bicarbonate exchange channel. While working on the cell biology of pDCs we were also the first group to show crucial role played by Piezo1 mechanosensors in human immune cells, e.g. in receptor- ligand endocytosis in pDCs, T cell activation and migration.

Speaker's Profile

Prof. Dipyaman Ganguly is currently Professor and Head, Biology, Ashoka University, Sonipat, Haryana. He earned his MBBS from Medical College, Kolkata, did a PhD in Biotechnology from Indian Institute of Chemical Biology Kolkata, another PhD in Immunology and Biomedical Sciences from UT MD Anderson Cancer Center, Houston, USA, and postdoctoral research in Columbia University, New York City, USA. His research interests are in human immunology and cell biology. He is a recipient of the Shanti Swarup Bhatnagar Prize in Medical Sciences, National Bioscience Award and Swarnajayanti Fellowship. He is an elected fellow of the Indian Academy of Sciences, Bangalore, India, and National Academy of Medical Sciences, New Delhi, India.

A slippery path in the diagnosis and management of tuberculous meningitis

Jayantee Kalita

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Tuberculous meningitis (TBM) is the commonest cause of sub-acute and chronic meningitis in South East Asia, and occurs in about 0.9% patients with tuberculosis (TB). The burden of TB is the highest in India. TBM has a high mortality (15%-40%) and neurological squeal (25%-50%). Tuberculous meningitis is a paucibacillary state; therefore, less than 40% patients have smear or culture positivity. TBM may be compounded with seizure, stroke, hydrocephalous, hyponatremia and drug induced hepatitis occurring in 30% to 60% patients. Paradoxical response is another issue during the treatment, and observed during 6-12weeks of antitubercular treatment. Our group has evaluated neuro-immunological and neuroendocrine basis of paradoxical response, drug induced hepatitis and cerebral salt wasting syndrome. The findings in the laboratory have been translated to bedside. In a randomized controlled trial, adjunctive fludrocortisone resulted in early normalization of serum sodium compared to standard treatment (4 vs 15 days). Fludrocortisone however did not correct fluid deficit. We have demonstrated association of cerebral salt wasting with severe stress leading to alteration in catecholamines, atrial natriuretic hormone (ANP), brain natriuretic peptide (BNP) and antidiuretic hormone (ADH). We have found early correction of hyponatremia and fluid deficit using adjuvant propranolol compared to placebo in CSW. We have reported TNFα as a biomarker of prolonged fever, and TNFα and IL6 as biomarkers of paradoxical tuberculoma. Rifampicin has a poor CSF penetration; therefore, we have done 2 randomized controlled trials evaluating the efficacy of levofloxacin in place of rifampicin in one, and add on levofloxacin on the other. After demonstrating the stroke and MR angiographic abnormalities in TBM, we also have evaluated the role of aspirin in preventing stroke. These challenges will be discussed.

Speaker's Profile

Dr Jayantee Kalita, Professor of Neurology, SGPGIMS, Lucknow has contributed to the diseases of national importance. She has original contributions in the field of encephalitis, dengue, tuberculous meningitis, peripheral neuropathy, stroke, cerebral venous sinus thrombosis, vitamin B12 deficiency, migraine and Wilson disease. Received Amrut Mody ICMR award, Fellow of Indian Academy Medical Sciences, National Academy of Medical Sciences, American Neurological Association and European Academy of Neurology. She is author of 5 books- Clinical Neurophysiology, Clinical electroencephalography, Tropical neurology, Management of neurological disorders, and Neurological consequences of nutritional deficiencies. She has published 588 original articles with a Citations of 20017, h-index: 72 and i10-index:338. Her outstanding contributions in Neurology have included her in the top 2% of global researchers in Stanford university list. She was also adjudged as top neuroscientist during 2015-17 based on her publications by CAREER 360, India. Dr. Jayantee is an excellent clinician, always willing to take clinical challenges. She enjoys teaching and is popular with students and residents.

Clinical research: Make in India

Ganesan Karthikeyan

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Many reasons underlie the poor quality and quantity of clinical research in the country. Of the research that does occur, much of it is not relevant to the needs of our people. This talk will focus on how we should address this need both generally, and with specific examples of work that we have done in the last 2 decades.

Speaker's Profile

Professor Karthikeyan is a clinical cardiologist and Professor of Cardiology at AIIMS, New Delhi, and currently serves as Executive Director of THSTI, an institute of BRIC, Department of Biotechnology. He trained at AIIMS and McMaster University, Canada, and is a Senior International Fellow at the Population Health Research Institute. He is a Fellow of the Academy of Medical Sciences, NASI, and the Royal College of Physicians, London. He is Editor-in-Chief of Open Heart (BMJ) and Associate Editor of several cardiology journals.

His research focuses on cardiovascular diseases in low- and middle-income countries, including rheumatic heart disease, mechanical valve thrombosis, anticoagulation, and indigenous stents. With 200+ publications in NEJM, Lancet, and JAMA, he is among the top 2% most-cited scientists globally. He serves on MTAB, chairs national cost-effectiveness reviews, contributes to PMJAY reimbursement packages, serves on the RhEACH Board, and advises the IAEA on research in resource-limited settings.

INSA New Fellow Lecture

Immunological features defining correlates of protection against Tuberculosis

Dhiraj Kumar

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Tuberculosis (TB) elimination is among the top priorities of the government. A crucial element required for TB elimination is having an effective vaccine. BCG, which is the only vaccine currently in use, provides very limited protection against adult TB. In recent times, several vaccine candidates have grown through pre-clinical and clinical development; however, much remains desired in terms of achieving a vaccine which is superior to BCG. Added to the above, failure to explicitly identify key immunological features which define the protective efficacy of any vaccine against TB makes pre-clinical assessment of new vaccine candidates vulnerable to subsequent failures at later stages of development. Our recent results on studying diverse cellular niches of Mycobacterium tuberculosis (Mtb) provide attractive clues towards the above. We report neutrophils as a critical cell type harboring intracellular bacteria in the TB lesions. Pathological neutrophil recruitment is driven by IL-17, which, contrary to its perceived protective role, triggers more pathology.

Our results show that neutrophils in the TB lesions are key producers of IL-17, thereby establishing a self-amplifying loop, exaggerating TB pathology. We show that lowering neutrophil infiltration and IL-17 production not only helps control TB pathology but also enhances the efficacy of protection by BCG. These pre-clinical results present exciting prospects of defining correlates of protection against TB and provide a framework for a new vaccine development strategy against TB.

Speaker's Profile

Dr Dhiraj Kumar is the group leader of the Cellular Immunology Group at ICGEB, New Delhi. His group works towards understanding innate immune responses during Mycobacterium tuberculosis infection with the aim of developing novel host-directed therapy against tuberculosis. His seminal work has earned him several national and international recognitions. As a part of a national consortium, he is also contributing to the TB genome surveillance program at the Pan-India level.

INSA New Fellow Lecture

Cellular and molecular mechanisms of virus induced neurodegeneration

Pankaj Seth

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Central Nervous System (CNS) are rare but can result in severe, life-threatening, or debilitating consequences. Several RNA viruses cause long-term effects post-infection, leading to neurocognitive and motor impairments, as well as neurodevelopmental disorders. The 2D and 3D cell culture models of human origin have emerged as ideal model systems due to their ability to accurately represent diseases and their physiological relevance. Our laboratory has developed well-characterized primary cultures of human fetal brain derived neural stem cells (hNSCs) to investigate viral neuropathogenesis caused by HIV-1, Zika virus, SARS-CoV2 and their associated proteins. Our findings provide novel insights into understanding the molecular mechanisms underlying Zika virus induced microcephaly via alteration in miRNA circuitry and disruption of BBB integrity. We have also identified SARS-CoV2 viral components that induce neuronal damage through a necroptosis pathway and involve mitochondrial dysfunction. These findings have been validated in brain sections from autopsy samples of COVID-19 patients. Currently, we are using iPSC derived human brain organoids to study if SARS-CoV2 may cause any defects in early events of brain development. Overall, the presentation would provide a spectrum of understanding of the cellular and molecular mechanisms for viral neuropathogenesis and cutting-edge tools employed for these studies.

This research is funded by NBRC Core funds and an extramural grant from the Department of Biotechnology, New Delhi, India.

Speaker's Profile

Novel insights gained through Dr Pankaj Seth's research has significant clinical importance in advancing the understanding of neurological complications arising as a consequence of CNS infections by RNA viruses, particularly the cognitive and motor deficits in HIV/AIDS, Zika virus induced microcephaly and Post-acute sequelae of COVID-19 in Long-COVID patients. He was the first researcher in India to establish human fetal brain derived neural stem cells, neurons & glia for neuroscience research. His pioneering development of iPSC-derived human brain organoids with microglia at NBRC marks a major advancement that has greatly enhanced India's capacity for personalized neuroscience research and translational medicine.

INSA Associate Fellow Lecture

Hijacking lysosomes for infection by SARS-CoV-2

Amit Tuli

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Lysosomes are the acidic cellular organelles responsible for the degradation of cargo from endocytosis, autophagy, and phagocytosis pathways. Along with this, lysosomes are shown to play an important role in maintaining the homeostasis of several cellular processes like cell signaling, metabolism, etc. Therefore, it's not surprising that many human pathogens alter the lysosome's functioning for their survival and pathogenesis. In my talk, I will discuss our recent findings on how SARS-CoV-2 viral infection affects lysosome functions. We found that the SARS-CoV-2 accessory protein, ORF3a, causes the deacidification of lysosomes and blocks endocytic and autophagic cargo degradation in lysosomes. Importantly, SARS-CoV-2 infection blocks the GTP hydrolysis of small G protein Rab7 (a key GTPase required for maintenance of lysosomal homeostasis) in an ORF3a-dependent manner, resulting in the hyperactivation of Rab7. These findings suggest that a key role of ORF3a is to promote Rab7 hyperactivation, which further facilitates viral replication and pathogenesis. Furthermore, ORF3a-mediated Rab7 hyperactivation impairs the transport of newly synthesized hydrolases to lysosomes and the fusion of lysosomes with other compartments consequently, thus promoting the exocytosis of the virus via de-acidified lysosomes. Taken together, the findings imply that during SARS-CoV-2 infection, ORF3a stalls the GTPase cycling of Rab7, an indispensable regulator of the endolysosomal pathway. This impairs the fusion of late endosomes with lysosomes, promotes the egress of the virus via lysosomal exocytosis, and supports the viral infection inside the host.

Speaker's Profile

Dr. Amit Tuli obtained his B. Tech. (Biotechnology) from Guru Gobind Singh Indraprastha University, Delhi; his Ph.D. (Biochemistry and Molecular Biology) from the University of Nebraska Medical Center (USA); and a postdoctoral fellowship from Harvard Medical School (USA). He is currently a senior principal scientist at the CSIR-Institute of Microbial Technology (CSIR-IMTECH), Chandigarh. Dr. Tuli's lab at CSIR-IMTECH is interested in investigating the host-pathogen interactions of highly infectious agents for which there are no effective treatments, and which pose serious health concerns.

INSA Associate Fellow Lecture

Title: Dynamic repertoire of resting brain to characterize healthy aging and common mental disorders

Arpan Banerjee

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Temporally stable patterns of neural coordination among distributed brain regions are crucial for survival. Recently, many studies highlight association between healthy aging and modifications in organization of functional brain networks, across various time-scales. Nonetheless, quantitative characterization of temporal stability of functional brain networks across healthy aging remains unexplored. Our lab has developed a data-driven unsupervised approach to capture high-dimensional dynamic functional connectivity (dFC) via low-dimensional patterns and subsequent estimation of temporal stability using quantitative metrics. Healthy aging related changes in temporal stability of dFC were characterized across resting-state, movie-viewing, and sensorimotor tasks (SMT) on a large (n = 645) healthy aging dataset (18–88 years). We reveal that temporal stability of whole brain resting-state follows a U-shaped curve along lifespan—a pattern shared by sensorimotor network stability indicating their deeper role in governing lifespan scale changes to brain dynamics. The unsupervised approach to chracterize temporal stability was extended to classify common mental disorders from fMRI cohorts (N = 408 participants). Patients with schizophrenia and ADHD demonstrate significantly reduced temporal stability compared to healthy controls. Whereas, bipolar disorder showed no quantifiable differences in functional connectivity dynamics compared to healthy controls/ Thus, through a series of studies ranging from healthy ageing to common mental disorders I highlight the potential of temporal stability as a biomarker for characterizing human well-being.

Speaker's Profile

Arpan completed his BSc Physics from Presidency College Calcutta; MSc Physics from University of Pune and PhD in Neuroscience from Center for Complex Systems and Brain Sciences, Florida Atlantic University. He has served in editorial boards of NeuroImage, Imaging Neuroscience, BMC Neuroscience, Discover Neuroscience (formerly Neural Development) and Frontiers in Computational Neuroscience. Dr Banerjee has received many awards and fellowships, Swartz Foundation post-doctoral fellowship (2007-2009), Ramlingaswami fellowship (2012), Bill and Melinda Gates Foundation award (2023-2025); Innovative Young Biotechnologist Research Award (2013). He was elected Fellow (Medical Sciences 2024) in the National Academy of Sciences in India (NASI)

Cellular Proteostasis Therapeutic Interventions & Challenges for Critical Diseases

Amit Mishra

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Cellular proteins are essential biomolecules that in their three-dimensional structures perform a diverse array of functions, which are essential for cellular homeostasis. Proteins are continuously being synthesised and degraded and protein quality control (PQC) machinery is needed for native folding via chaperones as well as regulated degradation of specific proteins by ubiquitin proteasome system (UPS). The components of PQC machinery chaperones and UPS can get dysfunctional or overwhelmed in neurodegenerative diseases, like Alzheimer's, Parkinson's, Huntington's and Amyotrophic Lateral Sclerosis, leading to protein misfolding and aggregation. Contrastingly, these components are overexpressed in many types of cancer cells and are associated with their protection, proliferation, and resistance to cell death. The modulation of these PQC components is an attractive strategy and some drugs have also been approved. However, the slow pace of drug discovery as well as acquisition of resistance in cancer cells are tough medical challenges. We utilise drug repurposing to find PQC modulators that exhibit anti-malignant action by studying effects on proteasome function, apoptosis, cell cycle molecules. For instance, NSAIDs like ibuprofen, indomethacin, and diclofenac induce proteasomal dysfunction, increase protein accumulation, promote cell death by mitochondrial pathway, and affect molecules associated with cell cycle in cancer cell line. Treatment of cell lines with anti-fungal drug itraconazole and natural compounds, like myricetin, lanosterol, and trehalose lead to increase in proteasome function as well as clearance of aggregates, which are linked with improved cellular health.

Speaker's Profile

Professor Mishra has developed a significant concept regarding selective E3 ubiquitin ligases that function as a first line of defence in quality control, offering ameliorative strategies against multifactorial proteostasis failures linked to neurodegenerative diseases and the challenges of ageing. His contributions to the field have been recognized through several prestigious national awards, including accolades from NAMS, INSA, NASI, BRNS, RIKEN, Max Planck and DBT, as well as international recognition. With over 150 high-impact publications in reputable international journals, Professor Mishra has established himself as a leading figure in neurobiology.

INSA Young Associates Lecture

Lacrimal glands in dry eye disease: A Study of human and animal models

Swati Singh

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Lacrimal gland (LG) secretes the aqueous component of tears, and inflammation of the LG causes aqueous-deficient dry eye (ADDE), a condition affecting millions worldwide. Most ADDE patients notice symptoms late in the disease when the gland has suffered significant damage. Current treatments for ADDE are only palliative, and there are no targeted therapies for regenerating the lacrimal gland. The pathophysiology of LG in ADDE was studied through clinical, histological, and molecular analyses of human glands and mouse models. The distribution and response of progenitor cells within human LGs to inflammation were examined using immunostaining and gene expression studies. Progenitor cells were found around the intercalated and interlobular ducts. Spatial transcriptomics of healthy human LGs identified Car6+ acinar cells and basal ductal cells as progenitors. Inflamed lacrimal glands show a significant increase in mesenchymal stem cell (MSC) expression but a decrease in epithelial progenitor cells. An autoimmune NOD-dacryoadenitis model and a microvascular clip-assisted duct ligation model (to mimic two subtypes of ADDE) were used to evaluate the regenerative and anti-inflammatory effects of MSC-derived extracellular vesicles. LG exhibited acinar atrophy and immune cell infiltration similar to that observed in diseased human lacrimal glands, but showed only mild recovery after EV injection into the gland. Single-cell analysis revealed increased stress responses, including autophagy, heightened immune cell activity, and a reduction in acinar clusters and progenitor cells within ADDE mouse glands. EVs did not influence the activity of acinar or myoepithelial cells but improved the response to stress and hypoxia in the injected glands.

Speaker's Profile

Dr. Swati Singh is a clinician-scientist who has been working on "Ocular surface & adnexa services" at the L.V. Prasad Eye Institute since January 2021. She recently completed her doctorate from Friedrich Alexander University, Germany, at the Institute for Clinical and Functional Anatomy as a part of her Alexander von Humboldt research award. Her research focus is 'Lacrimal Gland and Ocular Adnexa', where she has a substantial body of original work. She is also an early-career India Alliance DBT-Wellcome Trust fellow for her work on lacrimal glands.