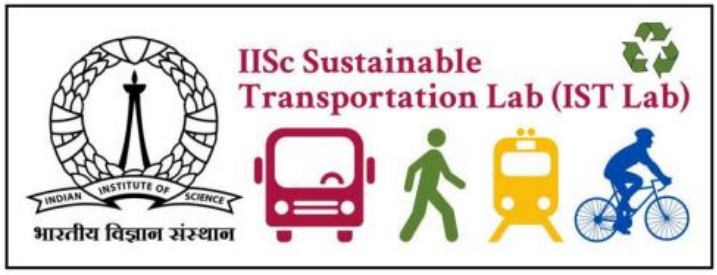
ANNUAL REPORT 2023



Convenor: Prof. Ashish Verma,

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MESSAGE FROM IST LAB CONVENOR

Dear IST Lab Collaborators and Friends

In the new year 2024, it is a good time to reflect into 2023 and see how our IST Lab productivity was during the whole year. In this regard, I am happy to present to you all the annual activity report of IST Lab.

Thanks

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INTRODUCTION

Dr. Ashish Verma, after joining IISc Bangalore in 2009 as Assistant Professor in the department of Civil Engineering established the Transportation Systems Engineering (TSE) lab. With almost fourteen years of impactful research work he revamped the lab's image with a new name and an official website. The lab is now named IISc Sustainable Transportation Lab (IST Lab). With this new image Prof Ashish Verma announced the first ever alumni meet on 9th January 2021 and created the 'IST Lab Alumni Group'. Since then, three alumni meets have been conducted (online). The fourth alumni meet was held on 27th January 2024. In this meeting, 2023 alumni group convenor Mr. Vivek Yadav and co-convenors Dr. Punjabeet Sarangi and Ms. Aparna P M presented about the various alumni activities conducted in 2023, and Prof. Ashish released the IST Lab. Annual alumni report for the year 2023 and described his views about the upcoming year 2024. He gave the role of alumni group convenor to Mr. Ashutosh Dumka and co-convenor to Mr. Saqib Gulzar. He assigned the role of coordinators to Ms. Almas Siddiqui and Ms. Maneesha B from the lab.

The report's purpose is to give the details of various activities and work done by the lab members and the achievements procured by the IST Lab in 2023. The report also showcases details about the alumni activities such as IST Lab alumni webinars and interviews.

IST LAB. RESEARCH CONTRIBUTIONS

JOURNAL publications in 2023

The IISc Sustainable Transportation Lab (IST Lab), recognized for its commitment in addressing the challenges of modern transportation through sustainable means, has had a prolific year in 2023. A total of 15 papers were published in 2023 in reputed journals, such as Journal of Air Transport Management, Simulation Modelling Practice and Theory, Cities, The International Journal of Urban Policy and Planning, Journal of Urban Planning and Development, Voices, Transportation, Journal of Choice Modelling, Adaptive Behavior, Physica A: Statistical Mechanics and its Applications, One Earth, Transportation in Developing Economies. The broad spectrum of issues addressed in these articles is indicative of the lab's comprehensive approach to transportation research and its commitment to addressing both current and future challenges. Full list of these journal publications is in the appendix.

CONFERENCE/ SYMPOSIUM acceptance & participation in 2023

In 2023, IST Lab members have made notable appearances in several key conferences, underscoring their commitment in advancing sustainable transportation solutions to the academic and professional community through conference presentations, publications, and participation. Over the course of year a total of 23 papers were presented in various conference proceedings of which 12 papers are been published and the rest in the process of publication. In addition to papers presented at Urban Mobility Research in India (UMI 2022), the proceedings of the Sixth International Conference of the Transportation Research Group of India (CTRG 2021), and the research paper work published at 102nd Annual Meeting of the Transportation Research Board (TRB) are amongst the 12 published papers. Significant appearances were also made at EUROSIM 2023 in Amsterdam, and three lab members attended the World Conference on Transport Research Society (WCTRS) that offers a platform for global exchange of ideas amongst transport researchers, managers, policy makers, and educators from all over the world. Full list of these conference publications is in the appendix.

IST LAB ACTIVITIES IN 2023

In 2023, there have been different activities conducted in IST Lab ranging from half-yearly review meeting, alumni activities (webinars and interview series), attending conferences such as WCTR, UMI 2023, launch of a new journal, IISc Open Day 2023 participation and festival celebrations. This section briefly mentions all these activities.

- The **third half-yearly review meeting was held on 28th April 2023** at The Golden Palms, Bengaluru. The lab members presented their research progress from the start of the Ph.D./M.Tech./Project till the meeting date with details of the timeline of their future works. The IST Lab team reached the venue at 8:45 AM followed by the buffet breakfast. The meeting started at 9:30 AM with a brief by Prof. Ashish Verma followed by presentations from Ms. Karthika PS, Mr. Furqan, and Ms. Hemanthini Allirani in the first session. After the session, a refreshment break was taken by the lab members where everyone played various indoor and outdoor games/sports like Carrom, Chess, Foosball, Badminton, Table Tennis, Squash, Mini Cricket, and Snooker. It was followed by the second session where Mr. Nipun Choubey, Mr. Rohit Singh Nitwal, and Mr. Kiran Naik gave their work presentations after which we had a lunch break. The session also had a surprise presentation from Prof. Verma in which he described his visit to Kashmir, J&K. Session 3 comprised presentations from Mr. Aitichya Chandra, Ms. Almas Siddiqui, and Mr. Yash Seth. It was followed by another activity-break session. During this break, the IST Lab members played musical

chairs and dumb charades. Mr. Furqan Bhat won the chair race and Mr. Veera Prabhu was the first runner-up. It was a fun time playing and watching the race. The last session of the day had the presentations of Mr. Harendra, Ms. Maneesha, Mr. Veera, Ms. Akshaya, Mr. Ankit, and Mr. Vaibhav. The day ended with high tea and group photographs.

Glimpses of different activities at The Golden Palms

Work Presentation by IST Lab

Few Candids of musical chair and other fun activities at Golden Palms

Group Photograph after completion of the half-yearly review meeting

- **IST Lab at IISc Open Day on 4th March 2023**:

  The IISc Open Day 2023 witnessed enormous participation and enthusiasm from the public. Thousands visited the campus to attain insights into the cutting-edge science and engineering research being conducted at the institute. The IISc Sustainable Transportation lab (IST Lab.) also planned a plethora of activities, demonstrations, and presentations to show how scientific decision-making help to address societally relevant transportation problems, including climate change mitigation, sustainable urban mobility, road safety, disaster resilience, and quality of life. People were welcomed to the IST lab through a very pertinent study titled “Microscopic Traffic Simulation Modelling to Evaluate Traffic Congestion Mitigation Measures on Roads around IISc Campus,” presented by Kiran. The study explained the comparative analysis of different alternatives (flyovers, extra widening, signal time improvisations, modal share increase of public transport, etc.) to avoid congestion on roads. Visitors were also informed about the bicycle gifted to Prof. Ashish Verma, by the mayor of Amsterdam, as a token to simulate and initiate bicycles as relevant means of transport in Bengaluru. The bicycle was placed in a designated selfie corner to encourage the promotion of non-motorized transportation and cycling. Harendra, a fellow lab member, encouraged people to visit IST Lab while briefing about the overall work summary of the IST Lab. He also presented his poster explaining the role of road accidents as the leading causes of death, injury, and hospitalization globally.

  The poster demonstration revealed that accidents not only affect the loss of life but also have an economic burden on society due to accidents of the most productive age group (15-49 years).

Rapid traffic growth plays an adverse role in road safety due to less availability of road space. Approximately 71 % of the victims in road accidents come from Vulnerable Road users (VRUs), i.e., pedestrians, bicyclists, and motorized two-wheelers. Some immediate safety measures like traffic rules & regulations and Engineering safety measures can help significantly reduce accidents. Visitors were notified that accident analysis throughout the city and microscopic examination would give insight into the further reduction of injuries and deaths. Some of the visitors were shocked to see the data of VRUs proportion of deaths in India, and were complaining about the congestion of Bengaluru, and met some visitors from the transportation industry. As visitors ventured further into our lab activities, they were greeted by Nipun and Karthika, who described the Kumbh Mela experiment. The Kumbh Mela experiment aimed to advance the understanding of crowd movement behaviour, crowd monitoring, and estimation techniques using multiple information sources and a set of state-of-the-art data fusion algorithms. There were two poster presentations - 1) a brief introduction to the Kumbh Mela experiment and 2) several empirical studies covering different aspects of crowd dynamics. Details related to the field data collection at Ujjain Kumbh Mela 2016 and experimental data collection were explained. The latter was also demonstrated using a controlled experimental setup where the participants of Open day were allowed to take part.

The experiment aimed to understand the behaviour of pedestrians under normal conditions vs. low visibility conditions. An L-shaped region was prepared with region-1 as the normal area and region-2 as the constrained area. Region-1 will provide unrestricted free-flow conditions under proper lighting. Region-2 was characterized by low visibility. The pedestrian movement was detected through GoPro cameras. Pedestrians enter from region 1 and exit through region 2. There were curtains spatting regions 1 and 2, thus, pedestrians did not have any information about the constraints before entering. Once the activity was completed, the participants were explained about the scope of the experiment and provided with survey forms recording their response behaviour and demographics. The experiment was planned and implemented by the team of Nipun, Karthika, and Aitichya, along with the help of other IST Lab members. A couple of the empirical studies were also explained through posters and simulation videos. Continuing the topic of simulation, Aitichya discussed the Air Traffic Model for Airspace (ATMA) of India. It is a predictive simulation software developed at IISc and is India's first air traffic simulation software. Visitors also witnessed the live air traffic around the Bengaluru region and were explained how the data is being processed through an Automatic Dependent Surveillance and Broadcast (ADS-B) antenna-dump setup. He also explained how his Ph.D. research focuses on the optimization of gate-to-gate air transport operations envisioned to help minimize operational delays and maximize airport efficiency while ensuring the safety of passengers. The possibility

of integrating the research solution into ATMA of India software to help air traffic control and management in India was also discussed.

Further, visitors observed the research aiming to understand the interaction between sustainable transportation measures and Quality of Life (QOL) by combining subjective and objective indicators. This work was presented by Hemanthini. The study involves two levels: (1) Local level - understanding the impacts on QOL due to pedestrianization of urban streets (2) Metropolitan, regional level - evaluating the network level effects on QOL due to sustainable transport measures. There was a poster presentation demonstrating the framework and a few results from the local-level study. An additional activity was "Vote!!! Your Voice Matters" in which, Polling was conducted on different transportation options from the perspective of transportation systems engineering, and people gave their vote by placing a dot against their preferred choices. The aim is to understand the public view on a few transportation measures discussed at the institutional level.

The options considered for polling are explained as follows:

1. Pedestrianization vs. Without Complete Pedestrianization:
    - Completely pedestrianized (vehicle-free) streets in urban centers and streets with higher pedestrian footfall
    - No change (Do nothing) scenario, i.e., streets include the interaction of pedestrians and vehicles.
    - People put on their perspectives based on their happiness, safety, and mental well-being to vote.
2. Congestion Pricing vs. No Congestion Pricing:
    - Congestion pricing is the concept of rush hour pricing used to divert the traffic during peak hours by making people choose different modes to commute or off-peak periods for travelling.
    - People voted with the perspective of decongesting the city centers.
3. Elevated Corridor vs. Metro Corridor:
    - Elevated corridor is generally suggested to solve Bengaluru's traffic problems.
    - Metro corridor can carry nearly 2,000 passengers at a time.
    - People voted based on their perceived comfort, convenience, etc.
4. Segregated walking or cycling lanes vs. More new roads for cars:
    - An infrastructural-based suggestion, i.e., segregated lanes for walking or cycling to avoid the intervention with motorized vehicles to mobilize safety for pedestrians and cyclists.
    - As car ownership is on the rise along with traffic congestion, more roads for cars are also demanded.
    - People voted for a scenario with the aspect of which promotes Quality of life.

Polling Results:

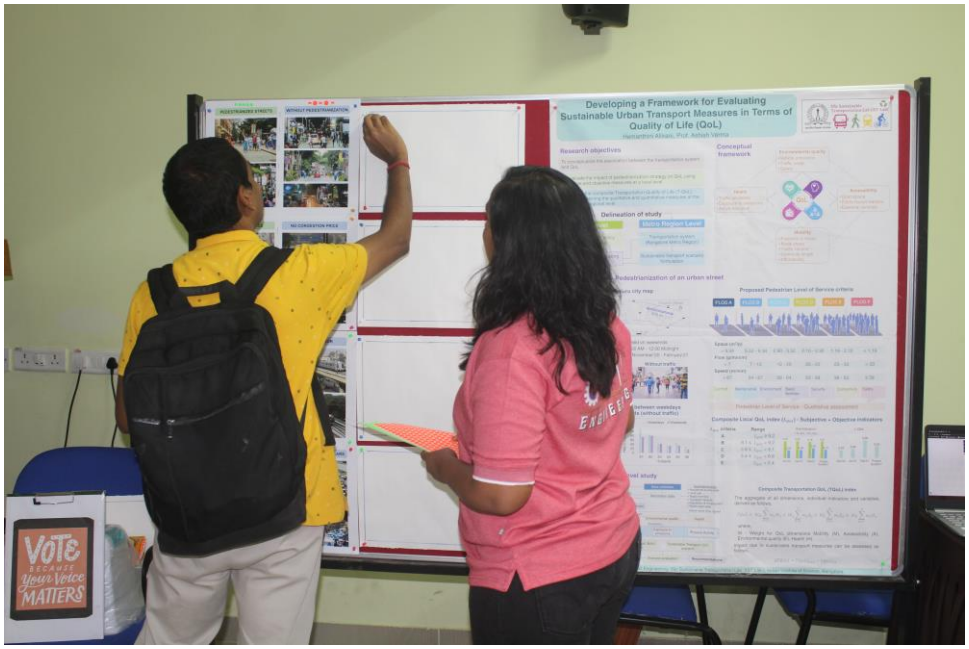
Total number of votes received: 239

Table 1. Voting results for different transportation aspects.

S. No	Option A	Option B	Votes for A	Votes for B	Votes for both	Votes for none
I	Completely Pedestrianized	Not Completely Pedestrianized	194 (81%)	44 (18%)	1 (0%)	0 (0%)
II	Congestion Pricing	No Congestion Pricing	182 (76%)	29 (12%)	0 (0%)	26 (12%)
III	Elevated Corridor	Metro Corridor	47 (20%)	185 (77%)	5 (2%)	2 (1%)
IV	Segregated walking or Cycling lanes	More new roads for cars	184 (77%)	40 (17%)	2 (1%)	11 (5%)

Note: Highest voted options are highlighted in red.

Options considered for polling



Participants voting for the poll

Maneesha explaining the game to school kids

Harendra explaining his poster to students

Kiran explaining school kids about traffic simulation

Nipun explaining Kumbh Mela Experiment to Registrar of IISc Bangalore

IST Lab members interacting with participants

Another lab member, Furqan, introduced the role of Electric Vehicles in sustainable urban mobility. He explained the factors affecting the adoption of electric vehicles in India. In addition, his demonstration also focuses on developing a model for the optimal placement of public electric vehicle charging stations. There was a poster presentation focusing on the details of the overall research. Details related to the data collection, methodology, data analysis, and results were explained. In addition, the EV charging infrastructure dashboard, which shows the location of the proposed EV charging stations based on the traffic patterns and the grid capacity in the city of Bengaluru, was also showcased. Furqan's exhibition was followed by Rohit, who presented a poster titled: "What are Sustainable Development Goals? See how transportation helps to achieve these goals." The poster depicted the importance of sustainable development and sustainable development goals. The main focus of the poster was to showcase and explain how transportation helps achieve these UN SDGs. Details related to transportation being a major contributor to global GHG emissions and other externalities, such as traffic accidents, Bengaluru floods, etc., were explained. The linkage between the United Nations' Sustainable Development Goals (SDGs) and transportation was discussed. A couple of indices were explained, which try to measure the current sustainability status of the transportation system. A simple and fun quiz was conducted by Maneesha and Akshaya with a focus on the little enthusiasts who visited IST Lab on Open day. The quiz contained three different sections of questions, all related to transportation. It was designed as a fun and engaging way of getting the little kids involved and excited about learning. Signs and marking, puzzles, and General Knowledge were the three categories from which the participant was able to choose by spinning a Spinning wheel. Upon answering the question, they were given gifts to show our appreciation and as a way to motivate and incentivize participation. The response was

overwhelmingly positive and wonderful. As visitors started leaving after going through the varied activities of IST Lab, they were requested to participate in a slogan hunt contest. Participants came up with exciting slogans about one of our IST lab projects. The ideology behind the contest was to conclude the message of IST Lab among the participants through feedback. One of our participants contested a slogan, “Do pedal but not juggle” with a view of promoting bicycling. The contest helped us to know the perspectives of people about our lab activities.

Aitichya showing his simulation work on air traffic control

Kids discussing the air traffic control simulation

Karthika explaining research work on Kumbh Mela Experiment

Participants of experiment set up for Pedestrian Safety

IST Lab with Prof. Ashish Verma after successfully conducting Open Day 2023

- **World Bicycle Day 2023 @ IISc Sustainable Transportation Lab. (IST Lab.)**: On World Bicycle Day 3rd June 2023, the IST Lab members re-iterate their commitment to advance the knowledge and understanding of sustainable modes like cycling, walking, and public transport, and their impact on Quality of Life (QoL) of people. This includes establishing causality between interventions like the ones that increase cycling mode share and its impact on physical, social, mental, and economic well-being of people, besides solving traffic problems.

- **World Conference on Transport Research Society (WCTR) 2023:** There were two presentations by Hemanthini AR on the titles “Modelling Traffic Fatalities to Assess the Significance of Gender in Road Safety” and “Study on Exposure to Particulate Matter ($PM_{2.5}$) in a Pedestrianized Street”. She also chaired the Session H5-S3: Traffic management & safety. Aitichya presented two papers, “Some Comments on the Aircraft Landing Problem: How Optimal is First Come First Serve Policy?” and “To Delay or Not to Delay? An Analytical Relationship Between Departure Delay, En-route Conflict Probability, and Number of Conflicts”. Furqan presented his paper titled, “Who will buy electric vehicles? Segmenting the young educated Indian buyers using cluster analysis”.

- **Inauguration of ITES:** As a part of the Memorandum of Understanding between India and United Kingdom, a new UK-India Net Zero Innovation Virtual Centre of which the ITES (Innovating for Transport and Energy Systems) initiative is a part, was established. ITES in India is led by IISc Sustainable Transportation Lab (IST Lab) on behalf of IISc in partnership with the UK, led by Energy Systems Catapult. ITES is backed by both Indian and UK governments, given their rich reputation for science, innovation, and technology.

  The physical space for the virtual centre was inaugurated by Hon'ble UK Minister of State for Science, Research and Innovation, George Freeman on 7th July 2023, in the presence of eminent dignitaries.

  The events that transpired on that eventful day are presented below.

Prof. (Dr.) Ashish Verma and Mr. Andrew Stokes receiving Hon'ble UK Minister George Freeman at the Main Building, IISc Bengaluru, accompanied by British Deputy High Commissioner Mr. Chandru Iyer.

Hon'ble UK Minister George Freeman arrives at Civil Engineering Department in Transvahan (an e-cart) to inaugurate ITES Centre.

Furqan Bhat (Research Scholar, IST Lab.) describing the Innovative for Clean Air (IfCA) project on optimization of EV charging infrastructure in Bengaluru for private vehicles, to Hon'ble UK Minister and Director, IISc.

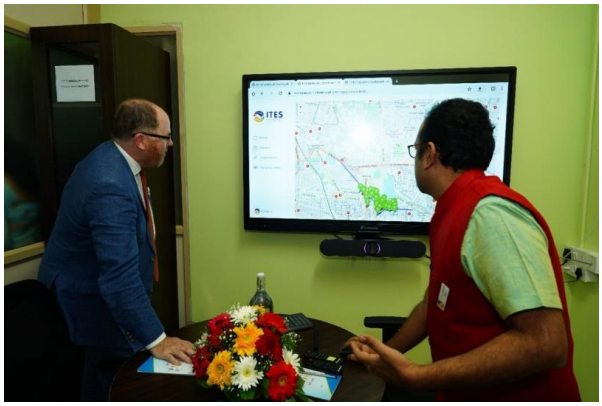
Karthika P S (Research Scholar, IST Lab.) describing the overall research work of IST Lab. to Hon'ble UK Minister.

Hon'ble UK Minister George Freeman cutting the ribbon for the ITES Centre along with Prof. Govindan Rangarajan, Director, IISc and Mr. Chandru Iyer, British High Commissioner.

Hon'ble UK Minister George Freeman delivering a speech after unveiling the plaque for the ITES Centre inauguration, in the presence of Director, IISc and other dignitaries.

Prof. (Dr.) Ashish Verma giving welcome remarks at the meeting with Hon'ble UK Minister George Freeman, in the presence of Director, IISc, held at Ramanujan- Newton Sabhagriha, ITES Centre

Mr. Sathya Sankaran (Urban Morph) presented the EV Dashboard for optimal location for EV charging station to Hon'ble UK Minister George Freeman in Raman – Rayleigh Kaksh, ITES Centre.



Mr. Andrew Stokes, from Energy Systems Catapult, explains the ITES centre's plan and its involvement in achieving net zero, to the Hon'ble UK Minister.

Hon'ble UK Minister George Freeman addressing on the UK-India Net Zero initiative with Prof. Govindan Rangarajan, Director IISc Bengaluru.

Hon'ble UK Minister George Freeman, Director, IISc and other dignitaries with Members from ITES and IST Lab on the ITES Centre inauguration.

A number of UK delegates and Indian officials were present on this important occasion of the inauguration of ITES centre. Small and medium enterprises, who can positively contribute to the vision behind ITES - to help shape the future of transportation in India - also participated and interacted with the dignitaries.

- Chandru Iyer, Deputy High Commissioner for Karnataka and Kerala
- Susie Kitchens, Deputy Director, Global Research & Innovation
- Sarah Fallon, Head of UK Science and Innovation Network, India
- Lucy Palfreeman, India and SE Asia Bilateral Lead
- Rachel Cordery, Private Secretary to the Minister
- Sunil Kumar, Senior Advisor, SIN India
- Andrew Stokes, Energy Systems Catapult
- Dr. Arun Harish, Chief Strategy Officer, CPI
- Dr Debashish Bhattacharjee, Vice President Technology and R&D, Tata Steel
- Tamil Chandru, Head of Programmes and People, SIN India
- Babita Sharma, Senior Advisor, SIN India
- Saiansha Panangipalli, Communications Lead, SIN India
- Dr Siddhartha Misra, Chief Process Research, R&D, Tata Steel
- Mr Subrat Kumar Baral, Chief, Alliances & Ventures, Tata Steel
- Ms Nabonita Das, Head, Innoventure, Tata Steel
- Mr Ashish Chaudhary, Growth Lead, Innoventure, Tata Steel
- Ms Latika Bhutani, Manager, Innoventure, Tata Steel
- Mr P V Dilip, Technology Lead, Innoventure, Tata Steel

List of SMEs

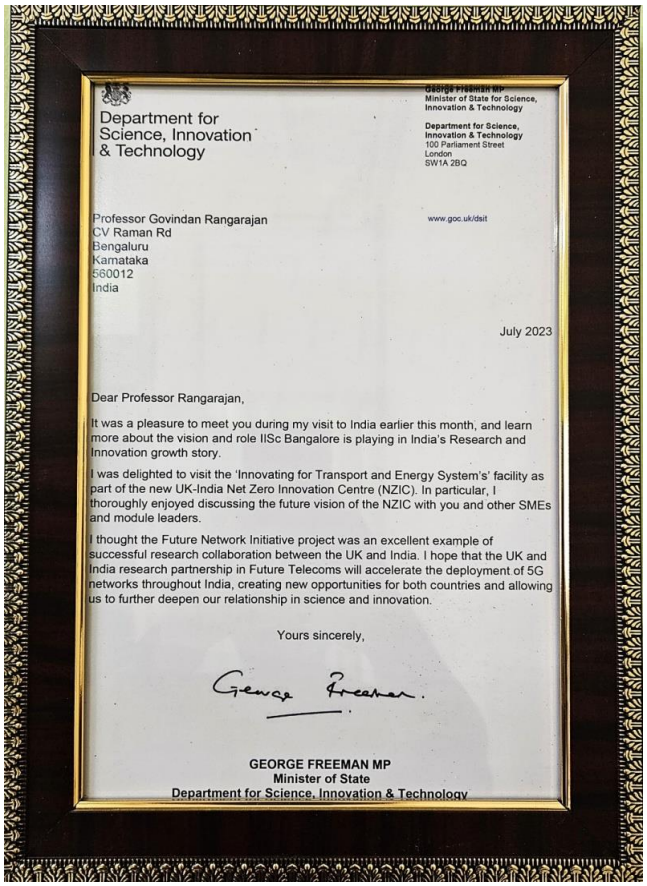
Indian SME: BUYMYEV

- Mr. Vivek Sharanappa - Co-founder/CEO

- Ms. Varsha Vasudeva - Co-founder/COO
- Mr. Aju Achuthan- Marketing Head

UK SME: LiNa Energy

- Jeetej Jandu - Director



Department for Science, Innovation & Technology

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July 2023

Dear Professor Rangarajan,

It was a pleasure to meet you during my visit to India earlier this month, and learn more about the vision and role IISc Bangalore is playing in India's Research and Innovation growth story.

I was delighted to visit the 'Innovating for Transport and Energy System's' facility as part of the new UK-India Net Zero Innovation Centre (NZIC). In particular, I thoroughly enjoyed discussing the future vision of the NZIC with you and other SMEs and module leaders.

I thought the Future Network Initiative project was an excellent example of successful research collaboration between the UK and India. I hope that the UK and India research partnership in Future Telecoms will accelerate the deployment of 5G networks throughout India, creating new opportunities for both countries and allowing us to further deepen our relationship in science and innovation.

Yours sincerely,

George Freeman.

GEORGE FREEMAN MP
Minister of State
Department for Science, Innovation & Technology

Thank-you letter from UK Science Minister George Freeman to IISc Director Govindan Rangarajan after the ITES Inauguration ceremony.

UK Research and Innovation

Department for Science, Innovation, & Technology

CATAPULT

ITES

Part of the UK-India Net Zero Innovation Virtual Centre

ITES Centre

INNOVATING FOR TRANSPORT AND ENERGY SYSTEMS

Officially Inaugurated by

GEORGE FREEMAN MP

Minister of State in the Department for Science Innovation and Technology

On 7th of July 2023

In presence of

PROF. GOVINDAN RANGARAJAN

Director Indian Institute of Science

MR. CHANDRU IYER

British Deputy High Commissioner, Karnataka and Kerala

and other dignitaries from India and UK

ITES Name Plaque in the entrance of ITES Centre.

ITES centre consists of a small conference room (Room 101 A) that can seat 4 people, a workplace (Room 101 B) and a large conference room that can seat 16-20 people (Room 101 C). Equipped with latest technology, they are named to reflect the India -UK collaboration for which ITES stand for – Raman- Rayleigh Kaksh, Bose – Higgs Karyasthal, and Ramanjunan – Newton Sabhagriha.

Room No:101(A)

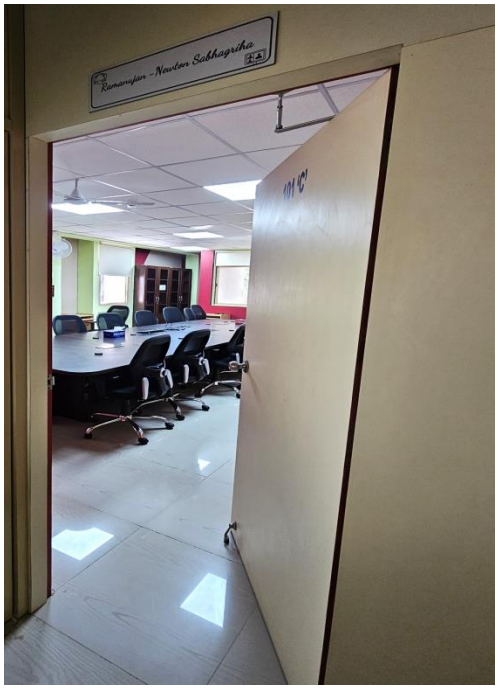
Raman–Rayleigh Kaksh

Room No: 101(B)

Bose–Higgs Karyasthal

Room No: 101(C)

Ramanujan–Newton Sabhagriha




ITES

Decoding "Ramanujan – Newton Sabhagriha"

Srinivasa Ramanujan was born on December 22, 1887, Erode, India. He was an Indian mathematician whose contributions to the theory of numbers include pioneering discoveries of the properties of the partition function.

In 1911 Ramanujan published the first of his papers in the Journal of the Indian Mathematical Society. His genius slowly gained recognition, and in 1913 he began a correspondence with the British mathematician Godfrey H. Hardy.

Ramanujan's knowledge of mathematics (most of which he had worked out for himself) was startling. Although he was almost completely unaware of modern developments in mathematics, his mastery of continued fractions was unequaled by any living mathematician. He worked out the Riemann series, the elliptic integrals, the hypergeometric series, the functional equations of the zeta function, and his own theory of divergent series, in which he found a value for the sum of such series using a technique he invented that came to be called Ramanujan summation. In England, Ramanujan made further advances, especially in the partition of numbers (the number of ways that a positive integer can be expressed as the sum of positive integers; e.g., 4 can be expressed as 4, 3 + 1, 2 + 2, 2 + 1 + 1, and 1 + 1 + 1 + 1). Generally unknown to the world at large but recognized by mathematicians as a phenomenal genius, without peer since Leonhard Euler (1707–83) and Carl Jacobi (1804–51), Ramanujan left behind three notebooks and a sheaf of pages (also called the "lost notebook") containing many unpublished results that mathematicians continued to verify long after his death.

Source- https://www.britannica.com/biography/Srinivasa-Ramanujan

Sir Isaac Newton (born December 25, 1642 [January 4, 1643, New Style], Woolsthorpe, Lincolnshire, England) was an English physicist and mathematician who was the culminating figure of the Scientific Revolution of the 17th century. In optics, his discovery of the composition of white light integrated the phenomena of colours into the science of light and laid the foundation for modern physical optics. In mechanics, his three laws of motion, the basic principles of modern physics, resulted in the formulation of the law of universal gravitation. In mathematics, he was the original discoverer of the infinitesimal calculus. Newton's Philosophiae Naturalis Principia Mathematica (Mathematical Principles of Natural Philosophy, 1687) was one of the most important single works in the history of modern science.

During the plague years Newton laid the foundations of calculus and extended an earlier insight into an essay, "Of Colours," which contains most of the ideas elaborated in his Opticks. It was during this time that he examined the elements of circular motion and, applying his analysis to the Moon and the planets, derived the inverse square relation that the radially directed force acting on a planet decreases with the square of its distance from the Sun—which was later crucial to the law of universal gravitation. He discovered the concentric coloured rings in the thin film of air between a lens and a flat sheet of glass; the distance between these concentric rings (Newton's rings) depends on the increasing thickness of the film of air.

Source- https://www.britannica.com/biography/Isaac-Newton

Sabhagriha is a Sanskrit word that merges **Sabha**, meaning assembly, and **Griha**, meaning hall. **Sabhagriha** means an **Assembly-hall.**

ITES will help shape the future of transport systems and address market challenges in India and the UK by bringing together cross-sector leaders across the value chain, academia, and government. ITES makes developing the new technologies and solutions Net Zero needs quicker and easier. This will help SMEs design, test, and grow safely with trial solutions in India, taking ideas from lab to market, and connecting with the ecosystem to develop products, services, and business models that succeed. It will equip cross-sector leaders with rock-solid data from high-quality, real-world pilots for informed policy and regulation decisions and investment in priority innovations. ITES unlocks business models and solutions that work in the real world by looking at the whole system – from consumer acceptance to supporting infrastructure and impact on the energy generation system.

ITES is currently focusing on the installation and testing of charge point technologies, flexible solutions such as smart charging and V2G, E-mobility solutions, software for optimization of transport energy use, energy storage/generation solutions linked to transport, testing of new business models and types of consumer engagement, installation and testing of clean energy supply for EV charging, system solutions for fleet decarbonization, the role of hydrogen in decarbonizing the transport sector, and whole system modelling to assess transport decarbonization pathways.

- **“Sustainable Transport and Livability” journal launch:** The journal “**Sustainable Transport and Livability**” was successfully launched on 7th November 2023 through an online event titled “Exploring the Linkages between Transport Systems and Quality of Life: Launching Sustainable Transport and Livability".

Nine speakers from academia, government, and NGO delivered their speech elucidating the need for sustainable and livable communities and how this journal can support research on exploring the linkages between transport systems and Quality of Life. Nearly, 286 participants had registered for the launch event from 35 countries across the world. Maximum members were registered from Asia (67.6 %) followed by Europe (16.0 %), Africa (7.6 %), North America (7.3 %), South America (0.7 %), and Australia (0.7 %).

Aim and Scope of the journal:

Sustainable Transport and Livability will focus on publishing research that **furthers our knowledge on the many linkages between sustainable transport and livability of cities and the policy, planning, design, and engineering interventions that affect these connections**.

These linkages of sustainable transport to livability may include impacts on:

- How sustainable transport interventions affect **physical, mental, economic, and social well being**
- How sustainable transport interventions can make society and individuals **healthier and happier**
- How sustainable transport interventions affect **quality of life, equity, social justice**
- How sustainable transport impacts **safety, accessibility, affordability, and environmental quality**
- How sustainable transport can contribute toward **improving disaster resiliency** of urban transport systems

In general, we will give preference to papers that evaluate or inform the **development** of transportation interventions to **improve livability of cities** and make an original contribution. The journal aims to cover sustainable transport and livability issues in both developed and developing economies with a potential of **transferability to other locations**.

The journal will particularly encourage submissions that are **cross-disciplinary or inter-disciplinary**. Submissions may include empirical studies, theoretical research, case studies, review articles, and conceptual papers. It encourages both **quantitative and qualitative** research approaches, and **transfer of research into practice**.

- **#BrandBengaluru CAMPAIGN:** The #BrandBengaluru initiative started by the Government of Karnataka covers eight verticals, one of which is mobility. Indian Institute of Science (IISc) and Ramaiah Institute of Management (RIM) were nominated as academic partners for the same. The campaign collected citizen feedback and suggestions through an online survey, which were then analyzed by the academic partners and presented in a stakeholder meeting on 8th August 2023. The Bruhat Bengaluru Mahanagara Palike (BBMP) held the Brand Bengaluru Conclave on October 9, 2023, to give experts a forum to meet, discuss and create recommendations for sustainable mobility. IST LAB members participated in analysing the customer feedback, stakeholders' suggestions and experts' opinions for a better agile Bengaluru. The #BrandBnegaluru report submitted to BBMP with short and long term recommendations from synthesis of citizens' feedback, stakeholders and experts

opinions is available in the IST Lab website. The link for the same is: http://civil.iisc.ernet.in/~ashishv/beta/banner/e098783753fac1f85f391869f40d4fe8r6.pdf

Stakeholder meeting


Brand Bengaluru Conclave

- **Urban Mobility India (UMI) 2023**:

The fourteenth Research Symposium with focus on "Integrated and Resilient Urban Transport" was held as part of the 16th Urban Mobility India Conference cum Exhibition from 28th – 29th October 2023 in New Delhi, India. The event was held under the aegis of the Ministry of Housing and Urban Affairs, Government of India and, it was coordinated this year by Dr. Manoj M., Associate Professor, Department of Civil Engineering, Indian Institute of Technology Delhi who is also an alumni of IST lab, IISc Bangalore. This was the first time that IIT Delhi was invited to coordinate the symposium. The symposium became a platform to highlight the current research activities in urban transport carried out by academic and research institutes, especially by young researchers. The purpose of the research symposium is to:

- Encourage young researchers working in various facets of urban transport to present their research work and provide them an opportunity for networking with fellow researchers and professionals.
- Carryout capacity building of young researchers in the field of urban transport, and
- Contribute towards building up of research database, its dissemination and identification of research thrust in the country.
- Encourage the idea of developing solutions for Indian conditions indigenously.

The theme of UMI conference is on "Integrated and Resilient Urban Transport". As part of the research symposium, abstracts of research papers are invited on the following broad themes.

- Integrated and resilient urban transport
- Sustainable Transportation Planning & Policy
- Public Transport and Non- Motorized Transport (NMT)
- Vulnerable Road Users (VRUs) and Inclusive mobility

- Land Use (LU) and transportation
- Urban Freight
- Electric, Emerging and Smart Mobility
- Urban Transport Governance

Lab members of Dr. Ashish Verma and Dr. Manoj M. at UMI Conference & Expo on 27th December 2023

IST lab Team at UMI RS 2023 on 28th December

Students of IISc Bangalore and IIT Delhi on 29th December 2023 at UMI RS 2023

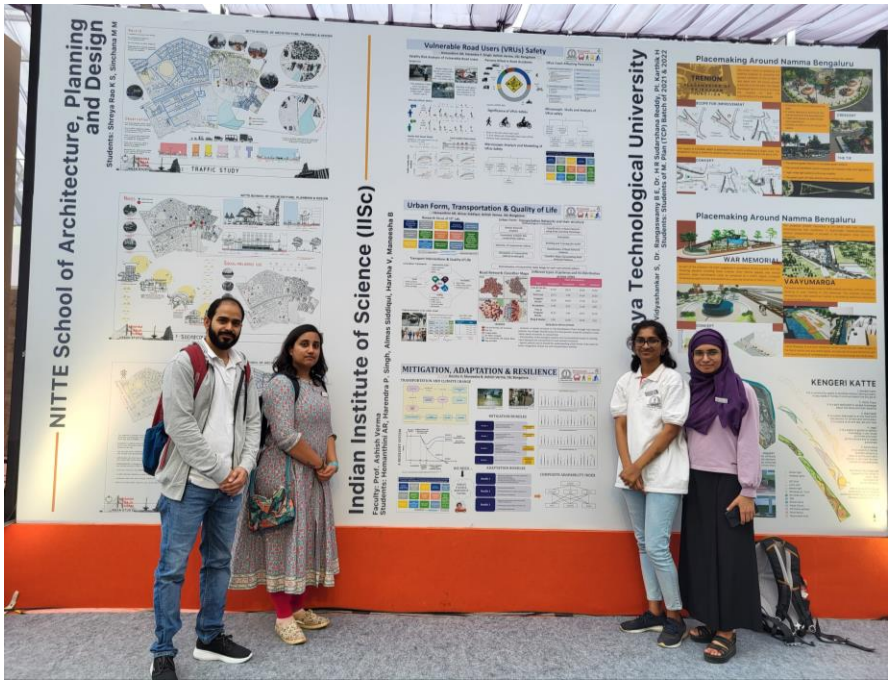
Following IST Lab members presented at the research symposium and Karthika P.S. won second best research apaper award.

1. Karthika P.S.
2. Nipun Choubey
3. Rohit Singh Nitwal
4. Furqan Ahmad Bhat
5. Almas Siddiqui
6. Maneesha B

- **7th Conference of Transportation Research Group of India (CTRG 2023):** There were two oral, one poster, and one doctoral research symposium presentations from IST Lab. Hemanthini AR won Best Poster Award for the paper titled “Evaluation of Change in Perception Before and After Pedestrianization of an Urban Street”. Aitichya won Best Paper Award for the paper titled "On the Possibilities of Efficient Air Traffic Monitoring through Complex Network Clustering Based Airspace Sub-Sectorization: A Multi-Objective Discrete Particle Swarm Optimization Approach".

- **NAMMA RAASTE Exhibition:** Namma Raste, a two-day exhibition and discussion organized by Bruhat Bengaluru Mahanagara Palike (BBMP) in partnership with World Research Insititute (WRI) India. This aimed to bring together academic institutions, volunteer or citizen groups, and government agencies and organizations to facilitate resilient, well-connected city roads in Bengaluru. IST Lab presented three works discussing vulnerable road user safety, the impact of sustainable urban policies, and connectivity of road networks with the types of network patterns. Participants included school children, college students, professors, social workers, citizens, professionals from consultancies and private sector, and officers from BBMP and other government agencies. Ms. Hemanthini Allirani, Ms. Almas Siddiqui, Mr. Harendra Pratap Singh, and Ms. Maneesha B represented

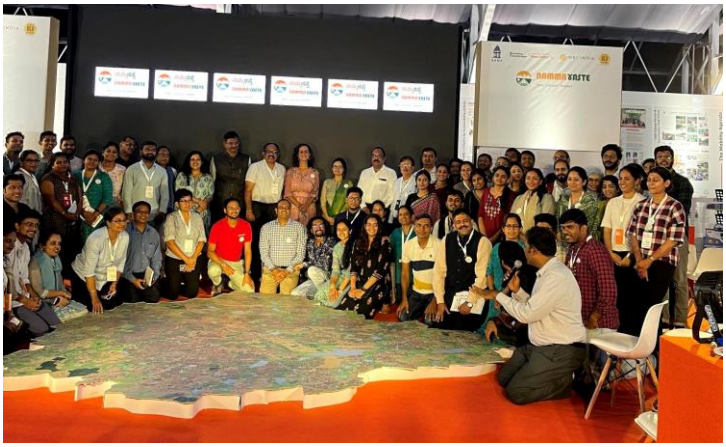
IST lab from IISc Bangalore. They met Prof. Prabhjot Kaur who recently joined IISc at Isaac Centre for Public Health. It was interesting to interact with people from different walks of life. The success of this event was profound due to which it was extended for three more days and citizens kept on coming to the exhibition to know more about the streets of the city.



IST Lab Team at Namma Raste Exhibition

Prof. Prabhjot Kaur with IST Lab Team

Students of Prof. Meghna Verma and VIT Student Aditya Verma with IST lab Team on second day of exhibition



Participants of Namma Raste Exhibition on second day

WRI India prepared a BBMP layout of road networks

Felicitation to IISc Bangalore for being an academic partner

- **Alumni Meet-up at TRB 2024, 103th Annual Meeting in Washington**:
  The IST Lab alumni meet was held during the TRB week. The meeting happened during lunch in an India restaurant Rasika in Washington, DC on 8th January 2024. Apart form the current attendees including Prof. Ashish Verma and Mr. Aitichya, three alumni were present. Dr. Divyakant Tahlyan, Mr. Saqib Gulzar, and Mr. Ashutosh Dumka. The lunch was full of vibrant discussions, interesting conversations, and delicious food. Ashutosh shared his experience as a new PhD scholar in Iowa State University. Dr. Divyakant and Saqib discussed their current research and future goals. Prof. Verma talked about the current and future projects of the IST Lab, the ITES center, IST Lab half yearly meetings, and the possible future events as part of the IST Lab alumni activities.

- **Visits of International faculties, collaborators etc. to IST Lab in 2023**
    - **Dr. Pushkin Kachroo (4th May 2023):**

      Prof. Pushkin Kachroo is the Lincy chaired Professor in the Department of Electrical and Computer Engineering at University of Nevada Las Vegas (UNLV). He obtained his Ph.D. in Mechanical Engineering from University of California at Berkeley performing research in Vehicle Control and obtained another Ph.D. in Mathematics from Virginia Tech in hyperbolic system of partial differential equations with applications to Traffic Control and Evacuation. He is finishing his Ph.D. in Physics from UNLV on the topic of Quantum Logic and Computation. He has been a professor at Virginia Tech, and a visiting Professor at University of California at Berkeley. His M.S. degrees are from Rice University.

      The presentation demonstrated the profoundly interdisciplinary nature of Intelligent Transportation Systems, providing insights into specific problem statements and their corresponding solutions that the speaker had been engaged in. Notably, the speaker delved into mathematical and modeling details concerning vehicle and traffic control issues. Additionally, the foundational theory of travel time dynamics, pioneered by the speaker, was discussed.

    - **Interaction Session with Dr Bhusan Kumar Upadhyay, IPS (29th April):**

      Dr BK Upadhyay is an IPS officer of Maharashtra cadre. Currently, he is serving as the Director General Police, Home Guards, Maharashtra. He heard from IST lab members about their research work and also shared his own experience

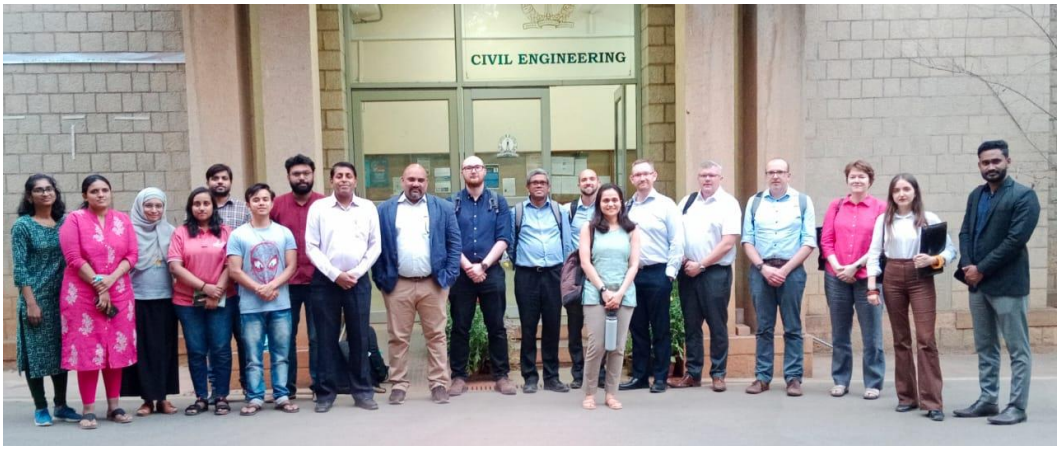
about reform measures taken during his tenure to improve traffic and other on-field challenges faced.

- **Meeting with delegates from Catapult and University of Manchester (15th March 2023)**

Prof. Asish Verma and IST lab members had a meeting with delegates from Catapult and University of Manchester on 15th March 2023.

The major point of the discussion centered around the concept of establishing twin cities for a shared sustainable research initiative, leveraging Bangalore and Manchester as the designated twin cities. The proposal involved comparing and evaluating the outcomes of both cities, allowing for customization based on the

findings. Additionally, there was a significant discussion on transitioning to cleaner energy vehicles, with a predominant focus on electric vehicles (EVs).



- **Guest lecture by Prof. Ralf Toumi, July 27, 2023:**

Members of the IST lab engaged in an interactive session with Professor Ralf Toumi, the Co-Director of the Grantham Institute for Climate Change and Environment at Imperial College London. During the session, IST lab members showcased their work, followed by a brief discussion. Subsequently, Professor Ralf Toumi presented the ongoing projects in his institute and engaged in further discussions with the lab members.

- **Visit by Mr. Frank van Poeteren, Chief Commercial Officer at InControl Enterprise Dynamics**

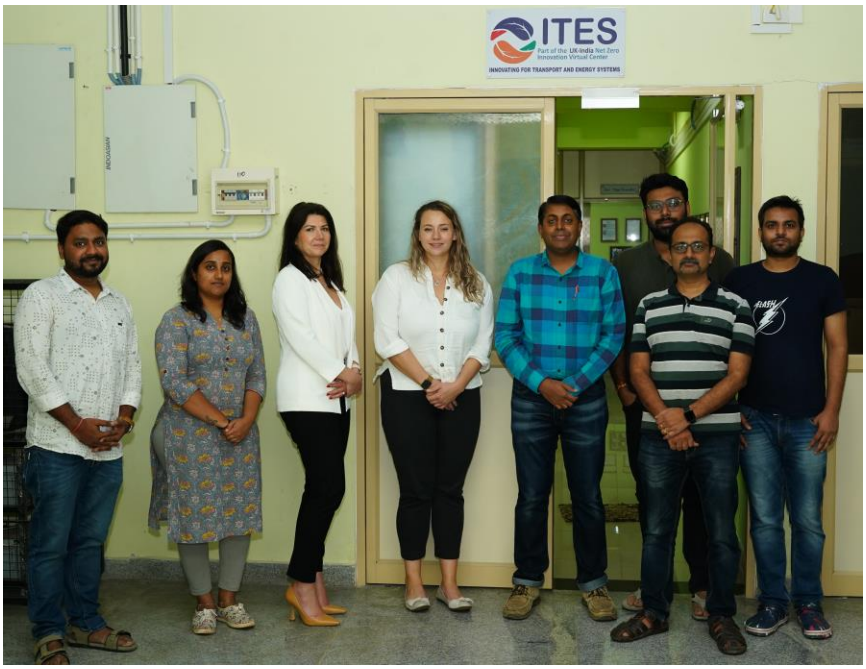
  Mr. Frank visited the IST Lab and ITES between 13th-14th October 2023. He along with Prof. Ashish Verma visited the Dutch Embassy on 13th October at Bangalore to explore the possibilities of Indo-Dutch collaborations through InControl Dynamics. The collaborations will focus on traffic flow control and management, sustainable mobility operations, and modeling of transportation systems. Mr. Frank also met with IST Lab research scholars, Mr. Nipun Choubey and Mr. Aitichya Chandra on 14th October 2023. Mr. Nipun and Mr. Chandra discussed IST Lab's overall work with specific focus on the Kumbh Mela Experiment, related big data collection, and sensing research, air traffic operations, related operations model, and solutions. The sensing, analytics, and simulation research of KME, and the operation research models in air traffic garnered a great deal of attention from Mr. Frank. Mr. Frank also provided a

detailed overview of the work and projects done at InControl and enthusiastically encouraged IST Lab members to explore career possibilities in InControl.

- **Meeting with Innovate UK UKRI delegates Charlie Fraser and Eva Bloch, (16th Oct 2023)**

  Innovate UK's India Partnerships Manager, Charlie Fraser, oversees the operations of Energy Systems Catapult came to IST lab on 16th October 2023. Energy system catapult center established with the goal of expediting the evolution of the UK's energy system, ensuring that both businesses and consumers in the UK can harness the benefits of clean growth. It stands as a key component within a distinguished network of technology and innovation centers initiated by Innovate UK.

The purpose of the meeting was to understand the various projects that people are working on in the IST lab and to discuss future collaboration between Energy Systems Catapult and the IST lab.



- **Delegates from University College London visited ITES on 22nd November 2023**
  The delegation included Professor Geraint Rees, Vice Provost (Research, Innovation & Global Engagement), Ciaran Moynihan Director of Global Engagement, Conor Rickford Joint Head of Global Engagement, Professor Monica Lakhanpaul, Global Strategic Academic Advisor (India), Professor Jolene Skordis Vice-Dean (International), Faculty of Population Health

Sciences, Professor Geoff Parker Professor Healthcare Engineering, Imaging, & Enterprise, Kirsty Walker Vice-President, External Engagement
The purpose of the visit was to discuss the potential ways of strengthening the cooperation further.

- **Indo-Dutch Meeting (7th December 2023)**

  Dr. Ashish Verma, Hemanthini Allirani, Furqan Ahmad Bhat, Rohit Singh Nitwal, Aitichya Chandra, Almas Siddiqui and Maneesha B from IST lab discussed with 4 Dutch delegates namely Mr. Willem Punt, the senior Desk Officer for India; Ms. Aleena Joseph, the Innovation Advisor at our Consulate; Ms. Van der Laan, our intern at the Political Department of the Netherlands embassy in New Delhi; and Anne Cremers, Deputy Consul General, Consulate General of the Kingdom of The Netherlands. They discussed about research works by lab members in the area of sustainable transport and urban mobility, on possibility of collaboration/cooperation with the Netherlands (InControl) and idea of setting up an Indo-Dutch centre of excellence on active mobility at IST lab, IISc Bangalore, India.


Research @ IST Lab.
PREMIER

- **Guest lecture by Dr. Pruthvi Manjunatha (12 December 2023)**

  Dr. Pruthvi Manjunatha is the I-STREET Emerging Technologies Program Manager and Research Assistant Professor in the Department of Civil and Coastal Engineering at the University of Florida, USA. He is an alumnus of IIT Bombay and Karlsruhe Institute of Technology, Germany.

  He gave lecture about the I-STREET program, a collaboration between the Florida Department of Transportation, City of Gainesville, and the University of Florida's Transportation Institute, aims to improve road users' mobility and safety through the deployment of advanced technologies like CAVs, smart devices, and sensors. The program showcases key projects and lessons learned.

- **IST Lab Alumni Activities**

  In 2023 various alumni activities were conducted, including seven Alumni Webinar Series and one Alumni Interview Series.

  - Alumni Webinar Series:

S. No.	Speaker	Date	Speaker's name & affiliation	Title of the webinar
1		18 Mar 2023	Dr. Hari Krishna Gaddam	Role of Macroscopic Continuum Models and Fundamental Diagrams in Traffic Flow Modelling, Management and Operations
2		22 Apr 2023	Mr. Anadi Pandharkar	Supply Chain Finance through a Blockchain Lens
3		26 May 2023	Mr. Vijit Vijayan	Introduction to PTV VISUM
4		24 June 2023	Ms. Revathy Nair	Modelling of Strategic Road Networks in UK using Saturn Software
5		26 Aug 2023	Dr. Punyabeet Sarangi	An Assessment of The Impacts of Intrahousehold Interactions on Household Activity-Travel Behaviour
6		25 Nov 2023	Mr. Saqib Gulzar	From material mechanics to systems analysis: a multiscale framework for infrastructure resilience
7		23 Dec 2023	Milan Mathew Thomas	A Novel Simulation Based Approach for User-Based Redistribution in Bike-Sharing System

- Alumni Interview Series

S. No.	Alumni Interviewee	Date	Interviewee's name & affiliation
1		21 Oct 2023	Mr. Ankit Rai, Consultant, Ministry of Railways

- Interactive session with Dr. Divyakanth, an IST Lab. Alumni, during their visit to IST Lab on 11th December 2023. There was an interesting discussion about the current research works going in transport planning field in India and USA. Dr. Divyakanth is currently a Postdoctoral Scholar at Northwestern University Transportation Center.

- **Festival celebrations in 2023**

  - Eid-Ul-Fitr celebration

Eid-Ul-Fitr was celebrated on 25th April 2023 in IST lab which was coordinated by Mr. Furqan Ahmad Bhat and Ms. Almas Siddiqui. A presentation was given by Almas on how and why eid is celebrated in Islam and what is the importance of Ramadan month.

- Ganesh Chaturthi Celebration

The festival of Ganesh Chaturthi was celebrated with much aplomb and enthusiasm by the lab members on the 18th of September. A rangoli was created as per the tradition while the celebrations started with Ganapati Puja. The Lab members Harendra Pratap Singh and Sital Kumar Sahu gave a brief summary about the Ganesha Chaturthi festival. The celebration ended with Ganpati Visarjan and a delicious Indian meal.

- Onam, Varalakshmi Puja and Independence Day festival

This year IST Lab celebrated Onam and Independence Day together on 25th August 2023. The lab members prepared a flower carpet to start the celebrations. We remembered prominent freedom fighters, about their post-independence contributions and achievements. Sardar Vallabhbhai Patel, Chandra Shekhar Azad, Sarojini Naidu, and Moulana Abdul Kalam Azad were commemorated by Rohit Singh Nitwal, Aitichya

Chandra, Ann Das, and Ankit Kumar Singh. A short insight into the festival of Onam was presented by Maneesha B. Lab members participated in the game of “Sundarikku pottukuthal” and the program concluded with lunch.

- Christmas Celebration 2023

December is a season of love, joy and peace. Christmas, the reason for the season, was observed on December 27, 2023, at IST Lab. Spreading the Christmas message and understanding the significance of this festival such as to spread love and hope for a better tomorrow were a few take aways from the presentation made by Ms. Ann Das on behalf of the celebration. Further, the carols were played vibing with celebration while the Christmas cake was sliced and distributed amongst the lab members by Prof. Ashish Verma.


PREMIER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IST LAB ACHIEVEMENTS IN 2023

In 2023 our lab members have received multiple awards, and patents. Some of these major achievements are presented below:

- **Prof. Ashish Verma** Appointed as Founding **Editor-in-Chief** of a new journal **"Sustainable Transport and Livability"** launched on 7th Nov. 2023 and published by Taylor & Francis (T&F).
- **Prof. (Dr.) Ashish Verma** Appointed as **Editorial Board Member** of **"Research in Transportation Business & Management",** Elsevier. (21-11-2023 onwards).
- **Prof. Ashish Verma** has been Elected as **Executive Council Member of Faculty Association** of **IISc Bangalore** (2023 to 2025).
- **Copyrights/Patents in 2023:**
  - **"Road Asset Management System"**, **(Date of Patent: 30-12-2020)** granted by The Patent Office, Government of India **(Patent No. 440090)**. Inventors: Ashish Verma, IISc Bangalore; Aruna Tiwari, IIT Indore; Sanjay Patidar, DTU; Neetesh Kumar, IIT Roorkee; Upendra Singh, SGSITS Indore.
  - Choubey N., Verma, A., & Chakraborty, A. (2023) **Copyright No: SW-16877/2023, Date of Grant:14-07-2023.** IISc-Ped-Sense (IPS): A machine learning based non-intrusive crowd parameter estimation tool for Indian scenarios [Software].
- IST Lab, together with Behaven and RIM, is among **top 75 ideas** to **promote sustainable behaviors in India**, in a **global challenge by NITI Aayog.**
- Ms. Karthika P S received the second-best prize for their research papers presented at UMI-Research Symposium 2023 held at Delhi as a part of 16th Urban Mobility Conference 2023, organized by the Ministry of Housing and Urban Affairs (MoHUA), Government of India and Institute of Urban Transport (IUT), India.

  Best Research Paper Award (2nd Prize)

  Authors: Karthika P S, Ashish Verma

  Title: Modelling the natural “pause-and-go” walking behaviour of pedestrians in bidirectional flow.

Karthika P S receiving Second Best Research Paper Award at UMI RS 2023

- IST Lab members received the Best Paper Award and the Best Poster Award at 7th CTRG 2023.

Best Paper Award

Authors: Chandra A., Hazra S., Verma A., Sooraj KP

Title: On the Possibilities of Efficient Air Traffic Monitoring through Complex Network Clustering Based Airspace Sub-Sectorization: A Multi-objective Discrete Particle Swarm Optimization Approach"

Aitichya Chandra receiving Best Paper Award at CTRG 2023

Best Poster Award

Authors: Hemanthini A.R., Ashish Verma

Title: Evaluation of Change in Perception Before and After Pedestrianization of an Urban Street

Hemanthini A.R. receiving Best Poster Award at CTRG 2023

- IST Lab members (Rohit, Furqan, Almas) Won various Medals across different sports in the event Spectrum 2023 (Inter-departmental Sports Meet) at IISc Bengaluru.

Name : Mr. Furqan Ahmad Bhat
Event : Badminton
Medal : Gold

Name : Mr. Rohit Singh Nitwal
Event : Kabaddi, Medal : Gold
Event : Basketball and Swimming, Medal : Bronze

Name : Ms. Almas Siddiqui
Event : Snooker
Medal : Silver

- **Mr. Rohit Singh Nitwal** Won **Gold** in **Basketball Men's tournament** at **IISM 2023** held at IISER TVM. This sports meet is attended by seven IISER's, IISc, NISER and CBS.

REPORT SUMMARY

This report captured the main IST Lab activities and achievements in 2023. Details are provided starting from the vision of Prof. Ashish Verma to revamp the Lab image to IST Lab activities to Alumni activities to various achievements bagged by our lab. The report consists of four sections starting from introduction, IST Lab research contribution, IST Lab activities in 2023, including the details about IST Lab alumni activities and various festival celebrations of the year 2023. Finally, the report showcased the IST Lab's achievements in 2023.

We thank all the alumni and current lab members who, with their hard work and research contribution, have made a positive impact in the field of sustainable transportation and mobility. Their contributions have brought several recognitions and laurels to the IST Lab. The future goal will be to continue this strive for excellence and improve the quality of life and transportation system in our society.

Appendix

List of Journal Publications:

1. Furqan A. Bhat., Meghna Verma., Ashish Verma.,(2024) Who will buy electric vehicles? Segmenting the young Indian buyers using cluster analysis, Case Studies on Transport Policy, Volume 15, 101147, ISSN 2213-624X, DOI: https://doi.org/10.1016/j.cstp.2024.101147

2. Aitichya Chandra, Nipun Choubey, Ashish Verma, K.P. Sooraj, (2024) Quasi-stochastic optimization model for time-based arrival scheduling considering Standard Terminal Arrival (STAR) track time and a new delay-conflict relationship., Journal of Air Transport Management, Volume 115, 102527, ISSN 0969-6997, DOI: https://doi.org/10.1016/j.jairtraman.2023.102527

3. Milan Mathew Thomas, Ashish Verma, Sai Kiran Mayakuntla, Aitichya Chandra, (2024) A novel simulation based approach for user-based redistribution in bike-sharing system.,Volume 131,102871,ISSN 1569-190X, DOI: https://doi.org/10.1016/j.simpat.2023.102871

4. Hemanthini Allirani, Ashutosh Dumka, Ashish Verma (2024) A framework for assessment of pedestrianization impacts on quality of life: Combining subjective and objective measures. Volume 145,104688,ISSN 0264-2751, DOI: https://doi.org/10.1016/j.cities.2023.104688

5. Bhat, F.A., Verma, A. (2023) Consumer intention to accept electric two-wheelers in India: a valence theory approach to unveil the role of identity and utility, Transportation, DOI: https://doi.org/10.1007/s11116-023-10430-z

6. Karthika P S., Ashish Verma.,(2023) Evaluating the gap choice decisions of pedestrians in conflict situations in mass religious gatherings and controlled experimental setup – A pilot study, Journal of Choice Modellilng, Volume 49, 100450,ISSN 1755-5345,DOI: https://doi.org/10.1016/j.jocm.2023.100450

7. Gayathri Harihara Subramanian, Meghna Verma, Ashish Verma (2023) Measuring Motivation and Satisfaction Level of Visitors of a Pedestrianized Urban Street in India for an Improved Quality of Life, Journal of Urban Planning and Development, ASCE, Volume 149, Issue 3, https://doi.org/10.1061/JUPDDM.UPENG-4225.

8. Karthika P. Sobhana, Ashish Verma(2023) Walking in Social Groups: Role of Intra-Group Interactions, Adaptive Behavior, Vol. 0(0) 1–14 https://doi.org/10.1177/10597123231182201.

9. Karthika P. Sobhana, Nipun Choubey, Ashish Verma, (2023) Modelling and simulating the leader-follower behaviour of pedestrians in unidirectional flow, Physica A: Statistical Mechanics and its Applications, Volume 623,128824, ISSN 0378-4371, https://doi.org/10.1016/j.physa.2023.128824.

10. Almas Siddiqui, Ashish Verma, Review of Institutional framework for Integrated Land Use Transport Planning: Case Study of Bengaluru, Urban Transport Research Journal, The 12th Urban Mobility India (UMI) Research Symposium - 2021, ISSN 2395-2492, pages 8-21.

11. Gayathri Harihara Subramanian, Ashish Verma, (2023)Have The Smart Cities in Karnataka Solved the Mobility Conundrum?, Urban Transport Research Journal, The 12th Urban Mobility India (UMI) Research Symposium - 2021, ISSN 2395-2492, pages 62-29.

12. Hemanthini Allirani, Ashish Verma, (2023)Impact Assessment of Pedestrianizing an Urban Street in Terms of Quality of Life, Urban Transport Research Journal, The 12th Urban Mobility India (UMI) Research Symposium - 2021, ISSN 2395-2492, pages 72-28.

13. Aitichya Chandra, Ashish Verma, K.P. Sooraj, Radhakant Padhi, (2023) Modelling and assessment of the arrival and departure process at the terminal area: A case study of Chennai international airport, Physica A: Statistical Mechanics and its Applications, Volume 615, 128590, ISSN 0378-4371, https://doi.org/10.1016/j.physa.2023.128590.

14. Ashish Verma, Jennifer Dunn, Alejandro Tirachini, Casper Boongaling Agaton, I-Yun Lisa Hsieh, Ahmad Mayyas, Shahana Althaf, Miloš N. Mladenović (2023), "Driving a sustainable road transportation transformation", Voices, One Earth, CelPress, Volume 6, ISSUE 1, P3-6. https://doi.org/10.1016/j.oneear.2023.01.002

15. Bhat, F.A., Verma, A.(2023) A Bibliometric Analysis and Review of Adoption Behaviour of Electric Vehicles. Transp. in Dev. Econ. 9, 5. https://doi.org/10.1007/s40890-022-00175-2.

16. Vajjarapu, H., Verma, A., & Hemanthini A. R. (2023). Evaluating the Climate Change Mitigation Potential of Sustainable Urban Transport Measures in India,Journal of Urban Planning and Development, Vol. 149, Issue 1, https://doi.org/10.1061/(ASCE)UP.1943-5444.0000890.

List of Conference Papers:

1. Choubey, N., Karthika, P.S., Reddy, G., Verma, A. (2023). Detecting Social Groups Using Low Mounted Camera in Mass Religious Gatherings. In: Verma, A., Chotani, M.L. (eds) Urban Mobility Research in India. UMI 2022. Lecture Notes in Civil Engineering, vol 361. Springer, Singapore. https://doi.org/10.1007/978-981-99-3447-8_21

2. Chandra, A., Allirani, H., Verma, A. (2023). Investigating the Effects of Individual and City Tier Characteristics on Motorized Two-Wheeler Usage Behaviour: A Multilevel Modelling Approach. In: Verma, A., Chotani, M.L. (eds) Urban Mobility Research in India. UMI 2022. Lecture Notes in Civil Engineering, vol 361. Springer, Singapore. https://doi.org/10.1007/978-981-99-3447-8_11

3. Nitwal, R.S., Siddiqui, A., Verma, A. (2023). Review of Transportation Relevant UN SDG Targets and their Association with Sustainable Transport Indicator s. In: Verma, A.,

Chotani, M.L. (eds) Urban Mobility Research in India. UMI 2022. Lecture Notes in Civil Engineering, vol 361. Springer, Singapore. https://doi.org/10.1007/978-981-99-3447-8_5

4. Verma, A. et al. (2023). A Critical Review of India's Urban Governance Reforms and Its Impact on Transport Sector: Case Studies of Bangalore and Jaipur. In: Verma, A., Chotani, M.L. (eds) Urban Mobility Research in India. UMI 2022. Lecture Notes in Civil Engineering, vol 361. Springer, Singapore. https://doi.org/10.1007/978-981-99-3447-8_3

5. Illahi, U., Subramanian, G.H., Verma, A. (2023). Choice Modelling-Based Policy Evaluation for Gender-Inclusive Mobility. In: Verma, A., Chotani, M.L. (eds) Urban Mobility Research in India. UMI 2022. Lecture Notes in Civil Engineering, vol 361. Springer, Singapore. https://doi.org/10.1007/978-981-99-3447-8_1

6. Bhat F. A., & Verma A. (2023). Consumer Intention to Adopt Electric Two-Wheeler in India: The Role of Identity and Utility. 102nd Annual Meeting of Transportation Research Board (TRB), January 8–12, 2023 (TRBAM-23-03229).

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