

Linköping University | Department of Science and Technology

Dr. Ram Kumar IISc Distinguished Visiting Chair Professor

Report of the Visit at IISc Bangalore March 2024 - April 2024

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The Visiting Chair Professorship was instituted by Dr. Rakesh Agrawal. It is named after his father, Dr. Ram Kumar, who was a student at IISc in the field of Electrical Technology in 1945. Dr. Rakesh Agrawal, until recently, was a Microsoft Technical Fellow and headed the Search Labs at Microsoft Research. He also served as a Distinguished Visiting Chair Professor at IISc. I sincerely thank Dr. Rakesh Agrawal for enabling this visiting professorship, which was a great experience for me.

Report of the visit

After my initial visit to IISc, I was honored to extend the Dr. Ram Kumar IISc Distinguished Visiting Chair position for a second term. During this visit, I spent six weeks at IISc Bangalore from March 4, 2024, to April 15, 2024. Returning to IISc for a second time provided the advantage of being already familiar with the environment, allowing me to delve straight into collaborative work without the initial phase of orientation. My host, as in the previous year, was Prof. Vijay Natarajan, head of the Visualization and Graphics Lab in the Department of Computer Science and Automation (CSA). Although Prof. Natarajan was on sabbatical in Germany, he was in Bangalore during my visit. Thus, I had the opportunity to meet him several times during my stay and engage with the students in his lab. In addition to my host group, I was warmly welcomed by the entire department, which facilitated interactions with other faculty members, attendance at talks, and participation in scientific discussions.

Main scientific interactions

The connection with Prof. Vijay Natarajan's lab continues to be a valuable source of intellectual engagement. I actively participated in group meetings, collaborated with students, and advanced joint projects. One of the projects I participated in was the development of a visualization system for ocean data, in collaboration with Prof. P.N. Vinayachandran from the Centre for Atmospheric and Oceanic Sciences. This work has resulted in a paper submitted to the Computer Graphics Forum (currently under review). Another major project involved the analysis of electronic transitions in dynamic molecular systems. This project, originally initiated under the Indo-Swedish Network project (<https://vgl.csa.iisc.ac.in/indoswedishproject/>), has evolved beyond its initial scope and established a robust ongoing collaboration. A publication of the results of this work is in progress. I also had the chance to participate in the doctoral defense of Mohit Sharma, who is part of this project. He will join my group in Sweden as a postdoctoral researcher this fall, further strengthening our collaboration.

The second main focus of my visit was the research collaboration with Prof. Tejas Murthy from the Department of Civil Engineering. This partnership, also rooted in the Indo-Swedish Network grant, centers on the analysis and visualization of granular and heterogeneous materials. This time, the focus of our work was on experiments with photoelastic discs performed in Prof. Murthy's lab. Although we had collaborated remotely between my visits, visiting the lab, seeing the experiment, and discussing it with him and his Ph.D. students was a different experience. We met multiple times during my stay, making significant progress in our research. As a direct outcome of this visit, we have submitted a paper to the TopoInVis workshop, a

co-located event at the IEEE Vis conference. A second paper is currently in preparation and is expected to be submitted by the end of the year.

I also visited the lab of Prof. Pradipta Biswas at the Centre for Product Design and Manufacturing and attended a talk organized by him. Toward the end of my stay, I visited the Center for Brain Research (CBR) again, resuming discussions that we had started a year ago. During this visit, I met the new director, Prof. K. V. S. Hari, and saw the impressive development of the center. Beyond my contacts at IISc, I met twice with Professor Jaya Sreevalsan-Nair from IIIT-Bangalore, gaining insight into her research institution.

I was pleased to present some of my research at the CSA Distinguished Lecture series. The title of my talk was "Tensor Field Visualization - Simple Visualizations for Complex Data?" The abstract was as follows: "There is general agreement that visualization can provide powerful tools for scientific data analysis, complementing automated analysis methods. In many areas, visualization has become an essential part of scientific workflows, supporting the understanding of and reasoning about data. However, upon closer inspection, one can see that only a few basic methods (such as colors, isosurfaces, and volume rendering) are truly established and widely used. The main reason for the success of these methods is that they provide intuitive, easy-to-understand, and accessible visualizations. Unfortunately, these methods mostly only target simple data types. When it comes to more complex data, such as multivariate data or tensor fields, the complexity of visualization concepts typically increases significantly, and their use in everyday work is more limited. These observations motivated us to attempt to generalize some of these basic methods to more complex data without increasing the complexity of the concepts too much. In this talk, I will present some results of these experiments, with a focus on tensor-valued data."

Summary Returning to IISc for a second time in what was already a familiar environment was a pleasure. I reconnected with many people and also made new connections. I had numerous interesting scientific discussions and personal encounters. The visit further established ongoing research collaborations with Vijay Natarajan and Tejas Murthy, and I hope that I can welcome them to Sweden at some point. Beyond the university, I further explored the fascinating city of Bangalore, with visits to museums and markets. I also made a trip to Hampi with other guest researchers I met at the guest house, expanding my perspective on the country. As before, I experienced a high level of hospitality, and I hope that I will have the opportunity to return sometime. I close with a big thank you to everyone who made this visit possible.

References:

- [1] Farhan Rasheed and Abrar Naseer and Emma Nilsson and Talha Bin Masood and Ingrid Hotz. "Multi-scale Cycle Tracking in Dynamic Planar Graphs". To be presented at IEEE VIS workshop on Topological Methods in Visualization, in October 2024.
- [2] Toshit Jain, Upkar Singh, Varun Singh, Vijay Kumar Boda, Ingrid Hotz, Sathish S. Vadhiyar, P. N. Vinayachandran, and Vijay Natarajan Toshit Jain, Vijay Kumar Boda, Varun Singh, Upkar Singh, Ingrid Hotz, Sathish S. Vadhiyar, P.N. Vinayachandran, and Vijay Natarajan. "A Scalable System for Visual Analysis of Ocean Data". submitted to Computer Graphics Forum (2024, under review).