Roshan Raghavendra Rao
Curriculum Vitae

Personal Information

Name: Roshan Raghavendra Rao
Place of birth: Bangalore, India
Date of birth: 23 Nov 1990
Nationality: Indian

Telephone numbers:
Mobile: (+39) 376 2282187, (+91) 9538725513
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Education since leaving school

2012 - Bachelor of Engineering in Mechanical Engineering, Nitte Meenakshi Institute of Technology (NMIT), Bengaluru an autonomous University affiliated to Visveswaraya Technological University, Karnataka State, India.
CGPA: 8.58/10
Project Title: "Numerical Simulation of Turbulent Flow past Micro Air Vehicle wing"
Project Advisor: Prof. Sekhar Majumdar (Professor Mechanical Engineering NMIT Bangalore)

2016- Master of Science (Engineering), Indian Institute of Science, Bengaluru.
CGPA: 6.1/8
Thesis Title: "A method to derive an aerosol composition from downward solar spectral fluxes at the surface"
Thesis Advisor: Prof. J. Srinivasan and Prof. S K Satheesh (Centre for Atmospheric and Oceanic Sciences, Indian Institute of Science, Bengaluru)

2023- Doctor of Philosophy, Indian Institute of Science, Bengaluru.
CGPA: 8.4/10
Thesis Title: "Exploring End-of-Life Photovoltaic (PV) Panel as a Building Material: A Case of Crystalline Silicon PV"
Thesis Advisor: Prof. Monto Mani (Centre for Sustainable Technologies, Indian Institute of Science, Bengaluru)

Present Appointment

Tecnologo (fixed-term Full-Time Employment) in Building physics and building energy systems group at the Free University of Bozen-Bolzano (UNIBZ), Faculty of Engineering

Period: from 01.10.2024 to present.
Employer: Free University of Bozen-Bolzano, Faculty of Engineering.
Supervisor: Prof./Dr. Gasparella, Andrea.
SSD: ING-IND/11 – Building Physics and Building Energy Systems.
Project: *"Development of tools and methods for assessment, monitoring and control of the performance of VENTILATED Facades" (FAIR: Project EFRE1035, CUP: D53C23003090005, Programme EFRE-FESR 2021-2027)*
Research Activities: Develop tools and procedures for the optimization of the performance of ventilated façades (transparent and opaque) in their life cycle, from design to construction and operational management. Characterization of the state of the art of measurements on ventilated facades and execution of tests on prototypes in the unibz laboratories at the NOI TechPark in Bolzano. Identification of best practices and KPIs for monitoring ventilated facades. Development and validation of numerical models for the characterization of ventilation in the cavity of ventilated façades and the evaluation of potential heat recovery strategies. Development of models for the characterisation of ventilated façades.

Professional Experience

Project Assistant at Divecha Centre for Climate Change, Indian Institute of Science, Bengaluru.

Period: Jun 2012 – Jul 2013
Employer: Divecha Centre for Climate Change, Indian Institute of Science, Bengaluru
Supervisor: Prof. J Srinivasan and Dr. Sheela Ramasesha (Divecha Centre for Climate Change, IISc)
During this tenure, I have worked on the following topics:
(a) Improvement assessment on using a dual axis tracking system for a flat photovoltaic system.
(b) Techno-commercial project (co-funded by Ministry of New and Renewable Energy, Govt. of India) involving installation of 20kWp grid tied three phase solar power plant on rooftop of Main Library (JRD Tata Memorial Library) in Indian Institute of Science campus.
(c) Performance study of CPV (Concentrated Photovoltaic) in an urban region (Bengaluru) of India.
The outcomes of these research works have been communicated as research article (2015) in Indian Academy of Science's Current Science Journal and a National Conference (2012) publication in Third National Conference on Climate Change held in Nov 2012 at Indian Institute of Science, Bengaluru.

Project Assistant at Interdisciplinary Centre for Energy Research (SERIIUS - Solar Energy Research Institute for India and the United States - project), Indian Institute of Science, Bengaluru.

Period: Sep 2016 – Jul 2017
Employer: Interdisciplinary Centre for Energy Research, Indian Institute of Science, Bengaluru
Supervisor: Prof. Monto Mani (Interdisciplinary Centre for Energy Research, IISc)
During this tenure, I have worked on the following topics:
(a) Photovoltaics performance monitoring of a BiPV (building integrated Photovoltaics) (b) Photovoltaics performance variability due to dust. The outcome of the research work includes a review article (2018) in the Elsevier's Heliyon Journal.

Research Associate (Provisional) at Centre for Sustainable Technologies, Indian Institute of Science, Bengaluru.

Period: July 2023 – Oct 2023
Employer: Centre for Sustainable Technologies, Indian Institute of Science, Bengaluru
Supervisor: Prof. Monto Mani (Centre for Sustainable Technologies, IISc)
During this tenure, I have worked on the following:
Research communication on the solar transmittance and thermal transmittance measurements of End-of-Life PV panels, climate responsiveness of building integrated with EoL-PV panels were made in peer reviewed journals and international reputed conferences.

Research Assistant (AR) (1-year fixed-term contract) in Building physics and building energy systems group at the Free University of Bozen-Bolzano (UNIBZ), Faculty of Engineering

Period: from 01.04.2024 to 30.09.2024
Employer: Free University of Bozen-Bolzano, Faculty of Engineering.
Supervisor: Prof./Dr. Pernigotto, Giovanni.
SSD: ING-IND/11 – Building Physics and Building Energy Systems.
Project: *VIAO-MI "Ventilation and Indoor Air Quality in Offices: Monitoring and Improvement" (CUP:30I55F21002050005)*
Research Activities: Experimental activities of air quality in office buildings to evaluate the effectiveness of different room ventilation. Development and calibrate models for the dynamic simulation of case-study buildings for the evaluation of the

effectiveness of different control strategies of the ventilation system and their optimization, considering energy, air quality, comfort for the occupants, and impact on their productivity.

Tecnologo (fixed-term Full-Time Employment) in Building physics and building energy systems group at the Free University of Bozen-Bolzano (UNIBZ), Faculty of Engineering

Period: from 01.10.2024 to 31.03.2026.
Employer: Free University of Bozen-Bolzano, Faculty of Engineering.
Supervisor: Prof./Dr. Gasparella, Andrea.
SSD: ING-IND/11 – Building Physics and Building Energy Systems.
Project: *"Development of tools and methods for assessment, monitoring and control of the performance of VENTILATED Facades" (FAIR: Project EFRE1035, CUP: D53C23003090005, Programme EFRE-FESR 2021-2027)*
Research Activities: Develop tools and procedures for the optimization of the performance of ventilated façades (transparent and opaque) in their life cycle, from design to construction and operational management. Characterization of the state of the art of measurements on ventilated facades and execution of tests on prototypes in the unibz laboratories at the NOI TechPark in Bolzano. Identification of best practices and KPIs for monitoring ventilated facades. Development and validation of numerical models for the characterization of ventilation in the cavity of ventilated façades and the evaluation of potential heat recovery strategies. Development of models for the characterisation of ventilated façades.

Other Academic Responsibilities

- Reviewer for Indian Academy of Science's Current Science Journal.
- Reviewer for Journal of The Institution of Engineers (India).
- Reviewer for Building Simulations Applications 2024 conference.
- Reviewer for Exploration of Neuroscience (Open Exploration Publishing) journal.
- Reviewer for Journal of Cleaner Production (Elsevier).
- Reviewer for Sustainable Energy Technologies and Assessments (Elsevier) journal.

Memberships

- International Solar Energy Society (ISES) Member since 2022.

Research and scholarships

- BHAVAN (Building Energy Efficiency Higher & Advanced Network), IUSSTF (2020) fellowship.
  The Scholarship was awarded to pursue collaborative research at the Lawrence Berkeley National Laboratory, Berkeley, USA. This works was in collaboration with Berkeley stepping in to identify sustainable end-of-life strategies to address the issue of mounting Photovoltaics waste worldwide.
  Funding agency: The Indo-U.S. Science and Technology Forum (IUSSTF)
  Funding Period: 6 months during 2020
  Fund **: USD 2500 per month. (~ EUR 2000 per month)

** fellowship was suspended due to COVID19 restrictions on travel.

- MoE (Ministry of Education, Government of India) Scholarship.
  The Scholarship was awarded to pursue Ph.D. at Indian Institute of Science, Bengaluru.
  Funding agency: MoE (Ministry of Education, Government of India)
  Funding Period: Aug 2017 – Aug 2022
  Fund: INR 42,000 per month. (~ EUR 468 per month)

- GARP Travel Grant
  The travel grant was awarded to present research paper at international conference in Bolzano, Italy
  Funding agency: GARP Travel Grant, IISc
  Funding Period: Jun 2022
  Fund: INR 1,98,000 (~ EUR 2200)

- Divecha Centre for Climate change Travel Grant
  The travel grant was awarded to present research paper at international conference in Vienna, Austria
  Funding agency: Divecha Centre for Climate change Travel Grant, IISc
  Funding Period: Apr 2016
  Fund: INR 1,22,000 (~ EUR 1300)

- MoE (Ministry of Education, Government of India) Scholarship.
  The Scholarship was awarded to pursue MSc(Engg.). at Indian Institute of Science, Bengaluru.
  Funding agency: MoE (Ministry of Education, Government of India)
  Funding Period: Aug 2013 – Aug 2015
  Fund: INR 12,400 per month. (~ EUR 138 per month)

Publications

- Journal articles in refereed academic journals

1. Priyadarshani Suchi, **Roshan R Rao**, Monto Mani, “Paradigm Shifts in Building Construction Priorities in the Last Decade”, Journal of the Indian Institute of Science, 2024, https://doi.org/10.1007/s41745-024-00437-5
2. Priyadarshani Suchi, **Roshan R Rao**, Mani M, Maskell D, “Examining Occupant-Comfort Responses to Indoor Humidity Ratio in Conventional and Vernacular Dwellings: A Rural Indian Case Study”, Energies, 2023; 16(19):6843. https://doi.org/10.3390/en16196843
3. **Roshan R Rao**, Monto Mani, “Review and preliminary insights into impacts between Photovoltaic (PV) installations and climate-change”, Current Science, VOL. 125 (9), 1-10 (2023) doi: 10.18520/cs/v125/i9/
4. A. Saifudeen, **Roshan R Rao**, and M. Mani, “Reassessing climate classification for buildings under climate change: Indian context,” World Development Sustainability, vol. 2, p. 100053, Jun. 2023, doi: 10.1016/J.WDS.2023.100053.
5. **Roshan R Rao**, Suchi Priyadarshani and Monto Mani, “Examining the use of End-of-Life (EoL) PV panels in housing and sustainability,” Solar Energy, vol. 257, no. June 2023, pp. 210–220, 2023, doi: 10.1016/j.solener.2023.04.033
6. **Roshan R Rao**, Monto Mani, Praveen C. Ramamurthy, “An updated review on factors and their inter-linked influences on photovoltaic system performance”, Heliyon 4 (2018) e00815. doi: 10.1016/j.heliyon.2018. e00815
7. **Roshan R Rao**, H. R. Swetha, J. Srinivasan and Sheela K Ramasesha, "Comparison of performance of solar photovoltaics on dual axis tracker with fixed axis at 13 degrees N latitude" Current Science, VOL. 108 (11),2087-2094(2015)

- Books Authored

1. **Roshan R Rao**, Raghavendra Rao B K, “An Introduction to Solar Photovoltaics, Waste Management and Legal Aspects”, ISBN 978-93-340-0324-6.

- Conference papers

1. **Roshan R Rao**, Monto Mani, “An Investigation into Thermal Bridging effects in an Envelope integrated with End-of-Life Photovoltaic panels”, 6th Building Simulation Applications 2024 (BSA 2024), Jun 26 – Jun 28, 2024, Bozen/Bolzano, Italy

2. **Roshan R Rao**, Monto Mani, “Examining the climate responsiveness of End-of-Life Photovoltaic (EoL-PV) integrated buildings ”, International scientific conference on the Built Environment in Transition (CISBAT 2023), Sep 13 – Sep 15, 2023, Lausanne & Fribourg, Switzerland
3. **Roshan R Rao**, Monto Mani, “Examining the applicability of End-of-Life (EoL) Photovoltaic (PV) panels as a building material ”, 40th European Photovoltaic Solar Energy Conference and Exhibition, Sep 18 – Sep 22, 2023, Lisbon, Portugal
4. ** Suchi Priyadarshani, **Roshan R Rao**, Monto Mani, “Studying Interventions to Regulate Indoor Hygrothermal Comfort in Building Integrated with End-of-Life (EoL) PV Panels ”, 40th European Photovoltaic Solar Energy Conference and Exhibition, Sep 18 – Sep 22, 2023, Lisbon, Portugal

   ***** Poster Award** - The presentation of Suchi Priyadarshani, Roshan R Rao, Monto Mani has been selected as **winner** in the thematic area of “PV Systems Engineering, Integrated/Applied PV at EU-PVSEC 2023.”*
5. **Roshan R Rao**, Suchi Priyadarshani, Monto Mani, “An Investigation into thermal performance of buildings built using upcycled End-of-Life Photovoltaic panels”, 5th Building Simulation Applications 2022 (BSA 2022), July 29 – July 01, 2022, Bozen/Bolzano, Italy
6. Suchi Priyadarshani, **Roshan R Rao**, Monto Mani, Daniel Maskell “Investigating the role of humidity on indoor wellness in vernacular and conventional building typologies”, 5th Building Simulation Applications 2022 (BSA 2022), July 29 – July 01, 2022, Bozen/Bolzano, Italy
7. **Roshan R Rao** and Monto Mani, “Degradation observation of 9 year old PV modules in Bengaluru, India”, 46th IEEE Photovoltaic Specialists Conference (PVSC-46), June 16-21, 2019, Chicago, Illinois, USA. DOI: 10.1109/PVSC40753.2019.8981278
8. **Roshan R Rao** and Monto Mani, “Case study on degradation of 8-year-old BiPV modules in Bengaluru, India”, 7th edition of the World Conference on Photovoltaic Energy Conversion (WCPEC-7), June 10-15, 2018, Waikoloa Village, Hawaii, USA. DOI: 10.1109/PVSC.2018.8547411
9. Gayathri Aadithya, **Roshan R Rao** and Monto Mani, “Integrability Comparison between BIPV and BAPV in Tropical Conditions: A Bengaluru Case-Study”, 2017 IEEE 44th Photovoltaic Specialist Conference (PVSC), Washington, DC, 2017, pp. 604-607. DOI: 10.1109/PVSC.2017.8366449
10. **Roshan R Rao**, Satheesh S K, J Srinivasan, “High resolution spectral irradiance measurements: Spectral aerosol radiative forcing and techniques to develop an aerosol model”, EGU General Assembly 2016, April 16-22, 2016, Vienna, Austria.
11. **Roshan R Rao**, Satheesh S K, J Srinivasan, “Estimation of optically equivalent aerosol composition using ground-based spectral irradiance measurements”, National Climate Science Conference, 2-3 July 2015 at Indian Institute of Science, Bengaluru
12. **Roshan R Rao**, Sheela K Ramasesha and J Srinivasan, “Performance Study of rooftop photovoltaic panels”, Third National Research Conference on Climate Change, November 3-4, 2012 at Indian Institute of Science, Bengaluru.
13. Siddharth Nair, **Roshan Rao**, Tarun Kumar, Guru Prasad G, Manish Kumar, Khadeeja Henna P, Aysha Saifudeen, Monto Mani, “Design of a Do-It-Yourself (DIY) based Solar Powered LED Lighting System for Training and Empowering Rural youth”, 7th International Conference on Research Into Design, 9 - 11 January 2019, Indian Institute of Science, Bengaluru, India
14. Tarun Kumar, **Roshan Rao**, Praveen C Ramamurthy and Monto Mani, "Safety of Light Emitting Diode (LED) Based Domestic Lighting Rural Context", 15th IEEE India Council International Conference (INDICON) (INDICON 2018), 16 – 18 December 2018, Amrita Vishwa Vidyapeetham, Coimbatore, India
15. Siddharth Nair, **Roshan Rao**, Tarun Kumar, Guru Prasad G, Manish Kumar, Khadeeja Henna P, Aysha Saifudeen, Monto Mani, “Roshini- Developing a DIY

Rural Solar Light: utilizing products at End-of-Life (EoL) stage", IEEE Global Humanitarian Technology Conference (GHTC 2018) 18 – 22 October 2018, San Jose, California, USA

Publications <u>about</u> the applicant

1. SuDesi Lab public outreach: rural solar electrification, conducted at Government Urdu High School, Chikkaballapur, Karnataka State, India (https://www.linkedin.com/posts/centre-for-sustainable-technologies-a170b6279_outreach-cst-goldenjubilee-activity-7160277945285058561-1nqq?utm_source=share&utm_medium=member_desktop)
2. An article has been published titled "Using end-of-life photovoltaic panels as building material" by EMILIANO BELLINI on August 4, 2023 in "pv magazine" (https://www.pv-magazine.com/2023/08/04/using-end-of-life-photovoltaic-panels-as-building-material/)
3. Few LinkedIn posts have been discussing the ongoing research conducted by Roshan R Rao at IISc :

   (a) **Planeta Pós-Pandemia (**https://www.linkedin.com/posts/planeta-p%C3%B3s-pandemia_energia-sol-aedndia-activity-7120809906554699776-aOuL?utm_source=share&utm_medium=member_desktop)

   (b) **pv magazine Global** (https://www.linkedin.com/feed/update/urn:li:activity:7093127952652988416?utm_source=share&utm_medium=member_desktop)
4. A popular daily newspaper "Deccan Herald" conducted a video interview on the ongoing research and is available on "Deccan Herald" youtube channel (https://www.youtube.com/watch?v=9KE3CGMwHVQ) and an article titled "Discarded solar panels power building dreams" has been published by Anand Singh on May 14, 2022 (https://www.deccanherald.com/city/top-bengaluru-stories/discarded-solar-panels-power-building-dreams-1109102.html)
5. An article has been published in page 52-53, August 16-31, 2017 issue of 'Down To Earth', an Indian science and environment fortnightly, under the headline "Shadows of LED - Exposure to LED lights could be harmful. Scientists suggest a simple solution".
6. An article has been published in page 7, November 5, 2012, of 'Bangalore Mirror', a daily newspaper in Bangalore, under the headline "Sunflower 'boost' for solar power; City-based IISc researchers show solar panels which track the sun's movement like sunflowers generate 20 per cent more energy than fixed panels"

Further data

1. Delivered one-day training to the research assistants as a part of RVE (Remote village electrification) scheme of MNRE (Ministry of New and Renewable Energy, Govt. of India) on difficulties and uncertainties of solar home systems working on the project headed by Dr. Hippu Salke at National Institute for Advanced Studies (NIAS), Bengaluru during **September 2013**.
2. Conducted a part of tutorial session on multi-layer earth atmosphere energy balance model in the "Training on Glacier, Climate Change and Remote Sensing" held at Divecha Centre for Climate Change, Indian Institute of Science, Bengaluru, India in **June 2015.**
3. Conducted a workshop session on Solar Photovoltaics and hands on session to build simple solar Photovoltaic LED lighting systems for homes to polytechnic college students at Sirsi district of Karnataka state in India during **December 2018** as a part of a collaborative project with Earthwatch Institute India.
4. Invited as an expert speaker for an online conference titled "SOLAR PANEL RECYCLING", organized by EUCI, USA to speak on "Can We Use End-of-Life Photovoltaic Panels as a Building Material?", held on **March 22, 2024**.

5. Conducted a one-day public SuDesi Lab outreach during **January 2024** on rural solar electrification, conducted at Government Urdu High School, Chikkaballapur, Karnataka, India.

Statement of interest

My experiences have shaped me into a motivated and resourceful researcher. My background in mechanical engineering, solar Photovoltaic systems, solar irradiance spectrum field measurements, modelling atmospheric radiative heat transfer, and atmospheric aerosol topics has enabled me to approach problems holistically and seek innovative solutions. I believe that I have developed unique ability to perceive the research problem through my doctoral research work involving building performance studies followed by my work on projects involving ventilation in office buildings and ventilated facades at Building Physics and Building Energy Systems group at the Free University of Bozen-Bolzano (UNIBZ). The comprehensive infrastructure, expertise and precedence set in the group at Building Physics and Building Energy Systems at the Free University of Bozen-Bolzano (UNIBZ) has filled in me, expanding and enriching my capabilities as an independent researcher.

The expertise that I gained on climate change topics, solar radiation and radiative forcing and especially ‘atmospheric aerosol’ topics during my master's degree has equipped me and motivated me to take up these topics of research from my heart. Moreover, I believe in the immediate societal relevance of research, and this position aligns with my desire to positively impact society through my work. To economize on writing, I have posted an exclusive 12-minute video discussing my research growth on my website (https://www.brightsunlabs.com/projects-6).

My strengths lie in systematic approach to handle tasks in hand. This has been one of the qualities I rely on and allows me to commit to a work with high degree of confidence. I have realized over time and failures, that breaking up a task to handleable size is a practical way to accomplish the work in hand works for me.

Language competence

I am confident in my English communication skills, both written and verbal, which have been crucial for publishing articles, presenting at conferences, and collaborating with international peers. The medium of instruction of my education in all the institutions that I have attended has been in English.

(Roshan R Rao)

Date

Signature