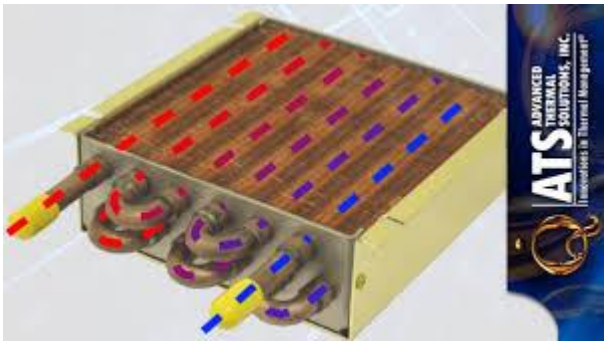
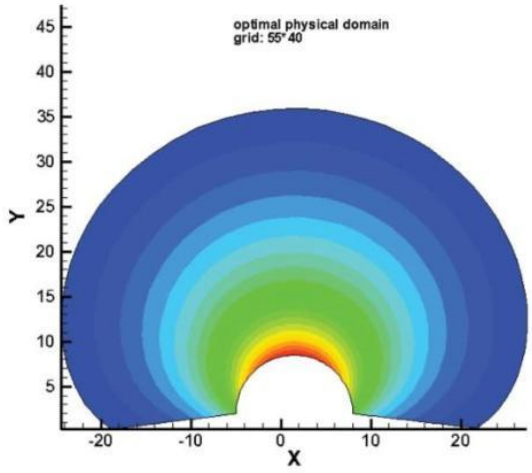
About Prof T. T. Narendran Institute Chair:

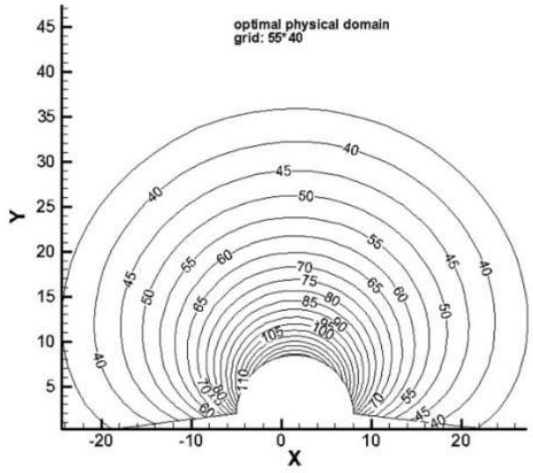
We have received benefactions from various Alumni Donors for Prof T.T.Narendran Institute Chair with a significant augmentation from Mr. Swaroop 'Kittu' Kolluri. This report encapsulates the activities in driving several initiatives by Prof.C.Balaji. He is a Professor of Mechanical Engineering at IIT Madras. He brought several activities on board. Let us now see those pursuits in detail.

Major and recent research conducted:

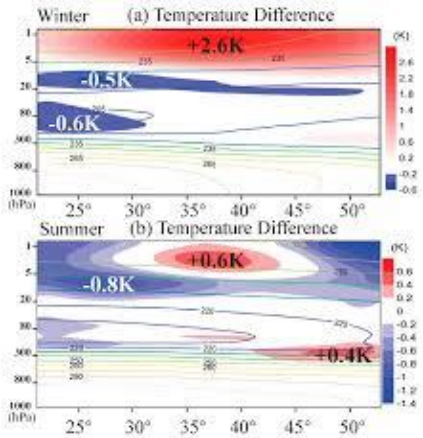


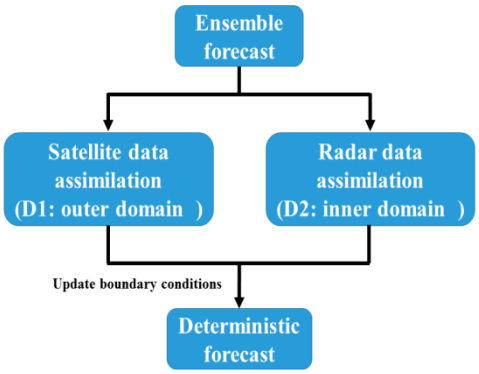
Heat Transfer and Optimization in electronic cooling





Inverse problems in Heat Transfer





Numerical Weather Prediction and Radiance Assimilation in the field of electronic cooling.

Prof. C. Balaji's research has been in 3 domains namely: Heat Transfer and Optimization in electronic cooling, Inverse problems in Heat Transfer and Numerical Weather Prediction and Radiance Assimilation in the field of electronic cooling. Prof. C. Balaji and his research group have demonstrated the importance of multi objective optimization in the design of heat sinks with phase change materials using a numerical and experimental data-driven approach. In the domain of inverse heat transfer, Prof. C. Balaji has introduced Bayesian methods in the heat transfer field and intuitive ways of generating priors to solve ill-posed inverse problems. Prof. C. Balaji's research group has demonstrated this approach in a wide range of problems from heat transfer to atmospheric science. They have developed new algorithms for ingesting microwave radiances from Indian satellites to improve the prediction of the Indian monsoon and tropical cyclones in the Bay of Bengal.

About the various activities pertaining to the research conducted:

Prof. C Balaji has taken several initiatives to bring several activities on board. Some of them are listed below:

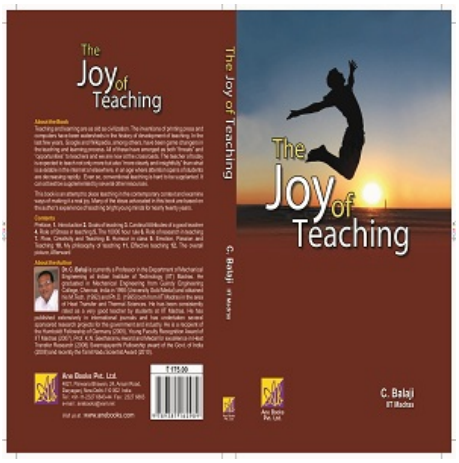
1. Designed, developed and taught a new a course on "Inverse Methods in Heat Transfer" which was very received with over100 registered students in both 2019 and 2020.
2. Prof. C. Balaji is one of the Investigators for the project "Mass-based hygroscopicity of ambient aerosols under contrasting environment over the eastern coast of India: Measurements and modeling in view of northeastern monsoon" sponsored by the Department of Science and Technology, Government of India.
3. Prof. C. Balaji is the Principal Investigator for the project "Multi-Satellite Radiance Assimilation to Improve Short to Medium Range Forecasts of the Indian Monsoon" sponsored by the Indian Institute of Tropical Meteorology under the National Monsoon Mission.
4. Prof. C. Balaji was one of the Investigators for the project "Dynamic downscaling to study climate change impacts on water resources in India" sponsored by the Ministry of Water Resources, Govt. of India.
5. Govinda Rao Y obtained his Ph.D. in July 2019. SangameshGodi obtained his Ph.D. in January 2020. Ch P R Sandeep obtained his Ph.D. in November 2020. Karthik Deo obtained his M.S. in July 2019.
6. Completed more than 5 PG projects and multiple UG projects.

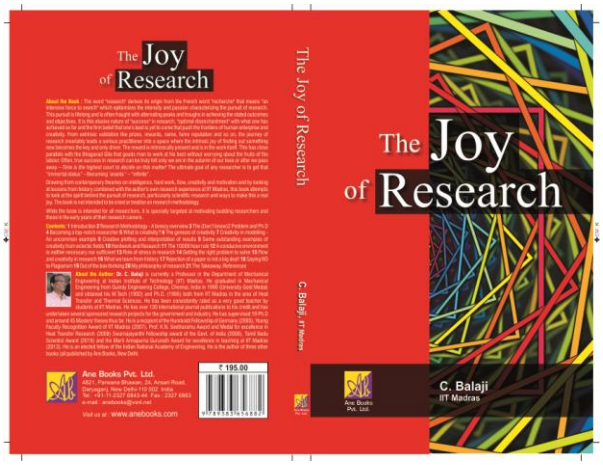
Books Published:

1. C. Balaji, Balaji Srinivasan, and SateeshGedupudi. Heat Transfer Engineering - Fundamentals and Techniques, 2020, Academic Press, Lomdonn

2. Baby, Rajesh, and C. Balaji. Thermal Management of Electronics, Volume I: Phase Change Material-Based Composite Heat Sinks - An Experimental Approach, 2019 Momentum Press.
3. Baby, Rajesh, and C. Balaji. Thermal Management of Electronics, Volume II: Phase Change Material-Based Composite Heat Sinks - An Experimental Approach, 2019 Momentum Press.
4. Thermal System Design and Optimization, 2nd Edn., 2019. Ane Books Pvt Ltd, New Delhi
5. SrikanthRangarajan, C Balaji - Phase Change Material-Based Heat Sinks: A Multi-Objective Perspective, 2019, CRC Press, New York.

His other Publications:





Journal Papers:

1. Kotresha, Banjara, NagarajanGnanasekaran, and ChakravarthyBalaji. "Numerical simulations of flow-assisted mixed convection in a vertical channel filled with high porosity metal foams." Heat Transfer Engineering 41, no. 8 (2020): 739-750.
2. Yenni, Govinda Rao, AmritAmbirajan, C. Balaji, and S. P. Venkateshan. "Emissivity estimation of spacecraft thermal control surfaces at cryogenic temperatures–A novel experimental approach." Heat and Mass Transfer 55, no. 5 (2019): 1465-1476.
3. Yadav, Rahul, C. Balaji, and S. P. Venkateshan. "Inverse estimation of number and location of discrete heaters in radiant furnaces using artificial neural networks and genetic algorithm." Journal of Quantitative Spectroscopy and Radiative Transfer 226 (2019): 127-137.
4. Godi, Sangamesh C., Satyanand Abraham, ArvindPattamatta, and C. Balaji. "Evaluation of candidate strategies for the estimation of local heat transfer coefficient from wall jets." Experimental Heat Transfer 33, no. 1 (2020): 40-63.
5. Yadav, Rahul, ChakravarthyBalaji, and S. P. Venkateshan. "ANALYSIS OF RADIATIVE TRANSFER IN BODY-FITTED AXISYMMETRIC GEOMETRIES WITH BAND MODELS AND ANISOTROPIC SCATTERING." Computational Thermal Sciences: An International Journal 11, no. 1-2 (2019).
6. Godi, Sangamesh C., ArvindPattamatta, and C. Balaji. "Effect of the Inlet Geometry on the Flow and Heat Transfer Characteristics of Three-Dimensional Wall Jets." Journal of Heat Transfer 141, no. 11 (2019).
7. Kumar Marri, Girish, and ChakravarthyBalaji. "Experimental and Numerical Investigations on a Phase Change Material Based Heat Sink with Symbiotically Joined Heat Pipe." Heat Transfer Engineering (2019): 1-18.
8. Yadav, Rahul, C. Balaji, and S. P. Venkateshan. "Optimization of number and locations of discrete heaters in a two-dimensional radiant heating furnace using artificial neural networks." (2019).

9. Marri, Girish Kumar, R. Srikanth, and C. Balaji. "Effect of phase change and ambient temperatures on the thermal performance of a solid-liquid phase change material based heat sinks." Journal of Energy Storage 30 (2020): 101327.
10. Kumar, Suraj, Pradeep S. Jakkareddy, and C. Balaji. "A novel method to detect hot spots and estimate strengths of discrete heat sources using liquid crystal thermography." International Journal of Thermal Sciences 154 (2020): 106377.
11. Kotresha, Banjara, NagarajanGnanasekaran, and ChakravarthyBalaji. "Numerical simulations of flow-assisted mixed convection in a vertical channel filled with high porosity metal foams." Heat Transfer Engineering 41, no. 8 (2020): 739-750.
12. Jyoteeshkumar, P., P. V. Kiran, and C. Balaji. "Chennai extreme rainfall event of 2015 under future climate projections using the pseudo global warming dynamic downscaling method." CURRENT SCIENCE 118, no. 12 (2020): 1968.
13. Singh, Alankrita, BalajiChakravarthy, and B. V. S. S. S. Prasad. "Numerical simulations and optimization of impinging jet configuration." International Journal of Numerical Methods for Heat & Fluid Flow (2020).
14. Godi, Sangamesh C., ArvindPattamatta, and C. Balaji. "Heat transfer from a single and row of three dimensional wall jets-A combined experimental and numerical study." International Journal of Heat and Mass Transfer 159 (2020): 119801.
15. Godi, Sangamesh C., ArvindPattamatta, and C. Balaji. "Heat transfer from a single and row of three dimensional wall jets-A combined experimental and numerical study." International Journal of Heat and Mass Transfer 159 (2020): 119801.
16. Chinta, Sandeep, and C. Balaji. "Calibration of WRF model parameters using multiobjective adaptive surrogate model-based optimization to improve the prediction of the Indian summer monsoon." Climate Dynamics 55 (2020): 631-650.
17. Akula, Rajesh, AthulGopinath, SrikanthRangarajan, and C. Balaji. "Experimental and numerical studies on heat transfer from a PCM based heat sink with baffles." International Journal of Thermal Sciences 159 (2020): 106525.
18. Akula, Rajesh, and ChakravarthyBalaji. "Thermal Performance of a Phase Change Material-Based Heat Sink Subject to Constant and Power Surge Heat Loads: A Numerical Study." Journal of Thermal Science and Engineering Applications 13, no. 3 (2020).
19. Marri, Girish Kumar, and C. Balaji. "Experimental and numerical investigations on the effect of porosity and PPI gradients of metal foams on the thermal performance of a composite phase change material heat sink." International Journal of Heat and Mass Transfer 164 (2020): 120454.
20. Kumar, Siddharth, R. Phani, P. Mukhopadhyay, and C. Balaji. "An assessment of radiative flux biases in the climate forecast system model CFSv2." Climate Dynamics (2020): (In press)
21. Kirthiga, S M, N. Balaji, and C. Balaji. "A multi-physics ensemble approach for short-term precipitation forecasts at convective permitting scales based on sensitivity experiments over southern parts of Peninsular India." Journal of Earth System Science (2020) (Accepted)

Conference Papers:

1. C. Balaji and Rajesh Akula, Thermal management of electronics working on periodic on-off cycles: A numerical study, International Conference on Advances in Applicable Mathematics (ICAAM-2020), Bharathiar University, Coimbatore, India
2. C. Balaji and Krishnamoorthy C, Ingesting multi-satellite radiances to improve the predictability of regional NWP model, International Conference on Ensemble Methods in Modelling and Data Assimilation, 24 - 26 February 2020, New Delhi, India
3. Sandeep Chinta, C. Balaji and V. S. Prasad, GSI Based Three-Dimensional Ensemble-Variational Hybrid Data Assimilation to improve the short-range prediction of the Indian

Summer Monsoon, International Conference on Ensemble Methods in Modelling and Data Assimilation, 24 - 26 February 2020, New Delhi, India

4. P. V. Kiran and C Balaji, Application of pseudo-global warming dynamic downscaling method to study the effects of climate change on rainfall events in Kerala, International Conference on Climate Services-6, 11-13 February 2020, Pune, India
5. Girish Kumar Marri and C. Balaji, Experimental investigations on miniaturized design of phase change material coupled heat pipe for cooling of portable electronics, 25th National and 3rd International ISHMT-ASTFE Heat and Mass Transfer Conference, December 28-31, 2019, IIT Roorkee, Roorkee, India
6. Rajesh Akula, Srikanth Rangarajan, and C. Balaji, Thermal Management of Transient Power Spikes in Electronics using a solid-liquid Phase Change Material based heat sinks: A numerical study, 25th National and 3rd International ISHMT-ASTFE Heat and Mass Transfer Conference, December 28-31, 2019, IIT Roorkee, Roorkee, India
7. Suraj Kumar and C. Balaji, Estimation of heat source strengths from flush-mounted discrete heat sources in a flat plate using Bayesian inference and synthetic data, 25th National and 3rd International ISHMT-ASTFE Heat and Mass Transfer Conference, December 28-31, 2019, IIT Roorkee, Roorkee, India
8. Sandeep Chinta and C Balaji, Adjusting WRF model parameters using Adaptive Surrogate Model-based Optimization to improve heavy rainfall forecast during Indian Monsoon, International Workshop on Prediction skill of extreme Precipitation events and tropical cyclones, 25 - 28 November 2019, Pune, India
9. Baki Harish, C Balaji, and Balaji Srinivasan, A preliminary study for GPM radar reflectivity assimilation in WRF model for tropical cyclones, International Workshop on Prediction skill of extreme Precipitation events and tropical cyclones, 25 - 28 November 2019, Pune, India
10. Sandeep Chinta, C. Balaji and V. S. Prasad, Impact of Assimilation of AMSU-ARadiances using GSI Based Hybrid EnVar System on Short Range Forecast of Indian Monsoon, 2019 Joint Satellite Conference, 28 September - 04 October 2019, Boston, USA
11. Baki Harish, C Balaji, and Balaji Srinivasan, Evolution of WRF cloud parameterization schemes by using GPM radar observations for the simulation of cyclone Fani, 39th International Conference on Radar Meteorology, 16-20 September 2019, Nara, Japan
12. Sandeep Chinta and C. Balaji, Impact of All-Sky Microwave Radiance Assimilation of Megha-Tropiques SAPHIR Data on Short-Range Weather Forecasts, 99th AMS Annual Meeting, January, 6-10, 2019, Phoenix, USA

Patents granted:

Rotatable heat sink – Inventors – SrikanthRangarajan and C.Balaji (Indian patent)