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## PROFILE

More than 25 years of experience in Mathematical Modeling of Materials Processing and Computational Fluid Dynamics (CFD) based Process Optimization, Design Optimization and Process Control for Sustainable Manufacturing and Energy Efficient Operations.

## EXPERIENCE SUMMARY:

Mar 2015 – Present: Professor, Department of Materials Science and Engineering, Indian Institute of Technology, Kanpur 208016, UP, India  
Sep 1991 – Mar 2015: Scientist, Tata Research Development and Design Centre, Industrial Research Division of Tata Consultancy Services, 54B Hadapsar Industrial Estate, Pune 411013

## EDUCATION

Ph. D., Department of Metallurgical and Materials Engg., Indian Institute of Technology, Kanpur, India, 2003

M. Tech., Department of Metallurgical and Materials Engg., Indian Institute of Technology, Kanpur, India, 1991

B. Tech., Department of Metallurgical and Materials Engg., Indian Institute of Technology, Kanpur, India, 1987

## Membership of Academic Bodies

- Member, Association for Iron and Steel Technology (AIST), USA
- Member, The Minerals, Metals and Materials Society (TMS), USA
- Life Member, Indian Institute of Metals (IIM), India
- Life Member, Materials Research Society of India (MRSI)
- Life Member, Indian Society of Heat & Mass Transfer (ISHMT), India

## Professional Awards / Honours Received

- Metallurgist of the Year Award, Ministry of Steel, Government of India, 2014
- Distinguished Scientist Award, TCS, 2011
- AICTE-INAE Distinguished Visiting Professor at IIT Bombay (2009-2012)
- Best Paper Award, Indian Institute of Metals-NMD 1993, 1996, 2000
- Convener, IMPRINT India Initiative
- Chairman, Resource Generation Committee, NMD-ATM 2016
- Convener, NMD-ATM 2014
- Member, National Council, Indian Institute of Metals, 2016-17
- Chairman, IIM Pune Chapter, Indian Institute of Metals, 2013-14
- Member of Review Board, Metallurgical and Materials Transaction B
- Member, Editorial Board, Transactions of Indian Institute of Metals
- Co-organizer, 4<sup>th</sup> ICME World Congress, Michigan, Ann Arbor, 2017

## List of publications

### Books

1. Nellippallil, A.B., Allen, J.K., Gautham, B., Singh, A.K., Mistree, F, Architecting Robust Co-Design of Materials, Products, and Manufacturing Processes. 2020. Springer.
2. Mason, P., Fisher, C. R., Glamm, R., Manuel, M. V., Schmitz, G. J., Singh, A. K., & Strachan, A. (Eds.). (2017). Proceedings of the 4th World Congress on Integrated Computational Materials Engineering (ICME 2017). Springer.

### Book Chapters

3. Chapter 6: Integrated Computational Materials Engineering for Determining the Set Points of Unit Operations for Production of a Steel Product Mix, Rishabh Shukla, Ravikiran Anapagaddi, Amarendra K Singh, Janet K. Allen, Jitesh H. Panchal, and Farrokh Mistree in Computational Approaches to Materials Design: Theoretical and Practical Aspects: Eds.: Shubhabrata Datta (Calcutta Institute of Engineering and Management, India) and J. Paulo Davim (University of Aveiro, Portugal) IGI Global, June 2016
4. B P Gautham, Pradip, S Sahay, A K Singh and Runkana Venkataramana, Model Collaboration, in Research by Design: innovation and TCS, Kanavi Shivanand, 2007, Rupa and Co, New Delhi, pp.161-171.

### Journal Papers

- J34. AB Nellippallil, V Rangaraj, BP Gautham, AK Singh, JK Allen, F Mistree, "An Inverse, Decision-Based Design Method for Integrated Design Exploration of Materials, Products, and Manufacturing Processes", *Journal of Mechanical Design*, doi: 10.1115/1.4041050 (2018)
- J33. Anirudh Deodhar, Umesh Singh, Rishabh Shukla, B. P. Gautham, Amarendra K. Singh, "Fast and Accurate Prediction of Stratified Steel Temperature During Holding Period of Ladle, *Metallurgical and Material Transaction B*, 48, 1217–1229(2017)
- J32. Rishabh Shukla, Ravikiran Anapagaddi, Amarendra K. Singh, Jitesh H. Panchal, Farrokh Mistree and Janet K. Allen, "Design Exploration to Determine Process Parameters of Ladle Refining for an Industrial Application", *Steel Research International*, DOI: 10.1002/srin.201500392(2016)
- J31. U. Singh, R. Anapagaddi, S. Mangal, K. A. Padmanabhan, A. K. Singh, "Multiphase Modelling of Bottom Stirred Ladle for Prediction of Slag-Steel Interface and Estimation of Desulfurization Behaviour" *Metallurgical and Material Transaction B*, DOI.10.1007/s11663-016-0620-2(2016)
- J30. Suryanaman Chaube, Gerald Tennyson, and A. K. Singh, "Modelling of Columnar-to-Equiaxed Transition and Inclusion Distribution in Continuously Cast Steel Billets", *Trans Indian Inst Met* 68(6):1207–1213, DOI 10.1007/s12666-015-0705-7(2015).
- J29. Akash Gupta, Ahmet Cecen, Sharad Goyal, A. K. Singh, S. R. Kalidindi, "Structure-Property Linkages for Non-Metallic Inclusions/Steel Composite System using Data Science Approach", *Acta Materialia*, DOI:10.1016/j.actamat.2015.02.045(2015).
- J28. R. Shukla, S. Goyal, A. K. Singh, J. K. Allen, F. Mistree, J. H. Panchal, "An Approach to Robust Process Design for Continuous Casting of Slab", *ASME-Journal of Manufacturing*, DOI: 10.1115/1.4029786 (2015)
- J27. R. Shukla, N. Kulkarni, B. P. Gautham, A. K. Singh, J. K. Allen, J. H. Panchal, F. Mistree, "Model Based Design Exploration of Engineered Materials, Products, and Associated Industrial manufacturing Processes: An Inductive Method", *Journal of Metals(JOM)*, DOI: 10.1007/s11837-014-1216-4 (2014).
- J26. H. Bhagwat, A. Singh and A. Sivasubramaniam, "Fast and accurate evaluation of cooling in

- data centers", *Journal of Electronic Packaging*, *Journal of Electronic Packaging*, 137, 011003(2015).
- J25. Akash Gupta, Sharad Goyal, A. K. Singh, K. A. Padmanabhan, "Inclusions in Steel: Micro-Macro Modelling Approach to Analyze the Effects of Inclusions on the Properties of Steel", *The International Journal of Advanced Manufacturing Technology*, DOI 10.1007/s00170-014-6464-5 (2014).
- J24. H. Bhagwat, A. Singh, A. Vasani, A. Sivasubramaniam, "Faster Exploration of Data center Cooling using Thermal Influence Indices", *Sustain. Comput. Inform. Syst.* 3 (2013), 120-131.
- J23. A. K. Singh, B. Basu, and A. Ghosh, "Numerical Simulations of Macroseggregation during Vertical Solidification", *Transactions of the Indian Institute of Metals*, 65, 179-190(2012).
- J22. A. K. Singh, B. Basu, and A. Ghosh, "Experimental investigation of macroseggregation during vertical solidification of lead-tin alloy", *Transactions of the Indian Institute of Metals*, 65, 85-96 (2012).
- J21. R. Pardeshi, A. K. Singh, V. Voller, and P. Dutta, "A Dual Scale Model for Macroseggregation in Alloy Solidification", *Numerical Heat Transfer, Part A*, 59,934-953(2011).
- J20. A. K. Singh, B. Basu, and A. Ghosh, "Mathematical modelling of convection and macroseggregation during casting of metallic alloys", *Int. J. Engineering Systems Modelling and Simulation*, 2, 226-233(2010).
- J19. R. Pardeshi, P. Dutta and A. K. Singh, "Modeling of Convection and Macroseggregation through Appropriate Consideration of Multiphase/multiscale Phenomena during Alloy Solidification", *Ind. Eng. Chem. Res.*, 48, 8789–8804(2009)
- J18. R. Pardeshi, A. K. Singh, and P. Dutta, "Modeling of solidification in a rotary electromagnetic stirrer", *Numerical Heat Transfer, Part A*, 55, 42 –57(2008).
- J17. R. Pardeshi, V. Voller, A. K. Singh and P. Dutta, "An Explicit-Implicit time stepping scheme for solidification models", *International Journal of Heat and Mass Transfer*, 51, 3399-3409(2008).
- J16. A. K. Singh, B. Basu, and A. Ghosh, "Role of appropriate permeability model on numerical prediction of macroseggregation", *Metallurgical and Materials Transactions B*, *Metallurgical and Materials Transactions B*, 37B, 799-809 (2006).
- J15. N. K. Nath, K. Mandal, A. K. Singh, B. Basu, C. Bhanu, S. Kumar, and A. Ghosh, "Ladle Furnace On-line Reckoner for Prediction and Control of Steel Temperature and Composition", *Ironmaking and Steelmaking*, 33, 140-150(2006).
- J14. A. K. Singh, B. Basu, and A. Ghosh, "Evolution of macroseggregation during directional solidification of binary alloys", *Ferroelectrics*, 306, 251-271 (2004).
- J13. R. Pardeshi, S. Basak, A. K. Singh, B. Basu, V. Mahashabde, S. K. Roy and Kumar, S., "Mathematical modeling of the tundish of a single-strand slab caster", *ISIJ International*, 44, 1534-1540, (2004).
- J12. A. K. Singh, S. Majumdar, B. Basu, and J. A. Sekhar, "The effect of heating element temperature on productivity", *Journal of Metals*, 54, 76-80 (2002).
- J11. N. K. Nath, A. K. Singh, A. Ghosh,, S. Banerjee, and S. Kumar: *Ladle Furnace On-line Reckoner – Part 1: Development of Models*. Tata Search, 2002, pp.119-125.
- J10. A. K. Singh, and B. Basu, "Numerical Study of Effect of Cooling Rate on Double-diffusive Convection and Macroseggregation in Iron-Carbon System", *ISIJ International*, 41, 1481-1487(2001).
- J9. A. K. Singh, R. Pardeshi and B. Basu, *Modeling of Convection during solidification of metal and alloys*, *SADHANA*, Vol. 26, pp. 139-162,2001.
- J8. A. K. Singh, and B. Basu, "On convection in mushy phase and its effect on macroseggregation", *Metallurgical and Materials Transactions A*, 31A, 1687-1692(2000).
- J7. A. K. Singh and D. Mazumdar "Mass Transfer between Solid and Liquid in Gas Stirred Vessels", *Met. Mat.Trans. A*, 28B, 95-102(1997).
- J6. A. K. Singh, and B. Basu, "Effect of Double-Diffusive Convection on Macroseggregation during Solidification of Iron-Carbon Alloy", *Journal of Energy, Heat and Mass Transfer*, Vol. 18, pp.31-37(1996).
- J5. A. K. Singh, and B. Basu, "Effect of Double-Diffusive Convection on Microstructure during Solidification of Iron-Carbon Alloy", *Trans. Indian Institute of Metals*, 48, 177-180 (1995).

- J4. A. K. Singh, and B. Basu, "Mathematical Modelling of Macrosegregation of Iron-carbon Binary Alloy:- Role of Double-Diffusive Convection", *Met. and Mat. Trans. B*, 26B, 1069-1081 (1995).
- J3. A. K. Singh and R. C. Sharma, "Phase Equilibria Calculation of Zn-Cd-Te System", *CALPHAD*, 16,161-172(1992).
- J2. A. K. Singh and D. Mazumdar, "Mathematical Modelling of Thermal Fields in Some Heat Treatment Operations", *Steel Research*, 63, 194-200 (1992).
- J1. A. K. Singh and D. Mazumdar, "Comparison of Several Numerical Prediction Methods for Thermal Fields during Phase Transformation of Plain Carbon Steels", *Iron and Steel Institute Journal Japan*, 31, 1441-1444 (1991).

Conference papers :

- C41. Abhishek Arya and Amarendra K Singh, "Effect of natural convection on formation and melting of shell around low melting point additives in steel" 178th ISIJ Meeting (Contribution of Steelmaking technology for the Sustainable development in Asia), Okayama City (Japan), CAMP-ISIJ, Vol.32, pp.470-473, 2019
- C40. Anand Balu Nellippallil, Vignesh Rangaraj, B. P. Gautham, Amarendra Kumar Singh, Janet K.Allen andFarrokh Mistree, "A Goal-Oriented, Inverse Decision-Based Design Method to Achieve the Vertical and Horizontal Integration of Models in a Hot Rod Rolling Process Chain", V02BT03A003; doi:10.1115/DETC2017-67570, Volume 2B: 43rd Design Automation Conference, Cleveland, Ohio, USA, August 6–9, 2017
- C39. A.B. Nellippallil, V., Rangaraj, J.K., Allen, F. Mistree, B. P. Gautham, A. K. Singh, A Decision-Based Design Method to Explore the Solution Space for Microstructure After Cooling Stage to Realize the End Mechanical Properties of Hot Rolled Product. In: Mason P. et al. (eds) Proceedings of the 4th World Congress on Integrated Computational Materials Engineering (ICME 2017). The Minerals, Metals & Materials Series. Springer,(2017)
- C38. G Tennyson, R Shukla, S. Mangal, S. Sachi and A. K. Singh, "ICME for Process Scale-Up: Importance of Vertical and Horizontal Integration of Models", Proceedings of the 3rd World Congress on Integrated Computational Materials Engineering (ICME 2015), Eds. Warren Poole, Steve Christensen, Surya Kalidindi, Alan Luo, Jonathan Madison, Dierk Raabe and Xin Sun, Published Online: 15 MAY 2015, DOI: 10.1002/9781119139508.ch2
- C37. Janet K. Allen, Jitesh Panchal, Farrokh Mistree, Amarendra K. Singh, BP Gautham, Uncertainty Management in the Integrated Realization of Materials and Components, Proceedings of the 3rd World Congress on Integrated Computational Materials Engineering (ICME 2015), Eds. Warren Poole, Steve Christensen, Surya Kalidindi, Alan Luo, Jonathan Madison, Dierk Raabe and Xin Sun, Published Online: 15 MAY 2015, DOI:10.1002/9781119139508.ch40
- C36. R Shukla, R Anapagaddi, A K Singh, J K Allen, F Mistree, J H Panchal, "A Method for Determining the Set Points of the Ladle, Tundish and Caster for Manufacturing a High Strength Steel Slab", Proceedings of the 3rd World Congress on Integrated Computational Materials Engineering (ICME 2015), Eds. Warren Poole, Steve Christensen, Surya Kalidindi, Alan Luo, Jonathan Madison, Dierk Raabe and Xin Sun, Published Online: 15 MAY 2015, DOI:10.1002/9781119139508.ch37
- C35. R. Shukla, R. Anapagaddi, R., A. K. Singh, J.K. Allen, F. Mistree, J.H. Panchal, "Exploring The Design Set Points Of Refining Operation In Ladle For Cost Effective Desulfurization And Inclusion Removal", Paper No. DETC2015-46265, pp. V02BT03A002; doi:10.1115/DETC2015-46265, 41st Design Automation Conference, Boston, Massachusetts, USA, August 2–5, 2015
- C34. A Deodhar, H Bhagwat, A K Singh, A Sivasubramaniam "Fast Prediction of Control Insights in Air-Cooled Data Centers Using Proper Orthogonal Decomposition", Proceedings of 2015 ASHRAE Winter Conference, Chicago, USA (2015)
- C33. A Deodhar, H Bhagwat, U Singh, D Sankaranarayanan, A K Singh, A Sivasubramaniam, "Coordinated Real Time Management of Return-Air-Temperature-Controlled Cooling Units in Data Centers", Presented at ASHRAE 2015 Winter Conference, Chicago USA. 24-28 Jan

2015. To be published in ASHRAE Transactions Volume 121, Part 1(2015).
- C32. R Shukla, S Goyal,, A K Singh, J H Panchal, J K Allen and F Mistree, "An Approach to Robust Process Design for Continuous Casting of Slab," ASME Design Automation Conference, Buffalo, New York. Paper Number DETC2014-34208 (2014).
- C31. R Anapagaddi, R Shukla, S Goyal, A K Singh, J K Allen, J H Panchal and F Mistree, "Exploration of the Design Space in Continuous, Casting Tundish," ASME Design Automation Conference, Buffalo, New York. Paper Number DETC2014-34254(2014).
- C30. A K. Singh, Sharad Goyal, Prabhask Kumar, Niranjana Reddy, K. A. Padmanabhan, Pabitra Palai, Yusuf Javed, P. K. Tripathy, Vinay Mahashabde, T. Venugopalan, "Prediction and Control of Center-line Segregation in Continuously Cast Slabs", Proc. International Conference on Science and Technology of Ironmaking and Steelmaking", STIS 2013, Jamshedpur, India
- C29. Ravikiran Anapagaddi, Rishabh Shukla, Saurabh Mangal, Amarendra K Singh, "Exploring the Design Space of a Continuous Casting Tundish for Improved Inclusion Removal and Reduced Dead Volume", Proc. International Conference on Science and Technology of Ironmaking and Steelmaking", STIS 2013, Jamshedpur, India
- C28. Akash Gupta, Ahmet Cecen, Sharad Goyal, A. K. Singh, S. R. Kalidindi, "Multiscale Model for Non-metallic Inclusions/Steel Composite System using Data Science Enabled Structure-Property Linkages", Proceedings of 2nd World Congress on ICME by TMS, Salt Lake City, Utah, US,2013
- C27. Janet K. Allen, Farrokh Mistree, Jitesh Panchal, BP Gautham, Amarendra Singh, Sreedhar Reddy, Nagesh Kulkarni, Prabhask Kumar, "Integrated Realization of Engineered Materials and Products: A Foundational Problem", Proceedings of 2nd World Congress on ICME by TMS, Salt Lake City, Utah, US, 2013
- C26. Akash Gupta, Prabhask Kumar, Ravikiran Anapagaddi, Niranjana Reddy, Sharad Goyal, A. K. Singh and K. A. Padmanabhan, "Integrated Modeling of Steel Refining, Casting and Rolling Operations to Obtain Design Set Points for Quality Steel Sheet Production", The 11th International Conference on Numerical Methods in Industrial Forming Processes, AIP Conf. Proc. 1532, 588-594; doi: 10.1063/1.4806880 (2013)
- C25. BP Gautham, Amarendra K Singh, Smita S Ghaisas, Sreedhar S Reddy, Farrokh Mistree,, "PREMAP – A Platform for the Realization of Engineered Materials and Products", ICoRD'13, Lecture Notes in Mechanical Engineering, (A. Chakrabarti and R.V. Prakash, Eds.), Springer (2013).
- C24 P. Kumar, S. Goyal, A. K. Singh, J. K. Allen, J. H. Panchal, F. Mistree,, PREMAP – Exploring the Design Space for Continuous Casting of Steel, ICoRD'13, Lecture Notes in Mechanical Engineering, (A. Chakrabarti and R.V. Prakash, Eds.), Springer (2013).
- C23. Harshad Bhagwat, Amarendra Singh, Arun Vasan, and Anand Sivasubramaniam, Thermal Influence Indices: Causality Metrics for Efficient Exploration of Data center Cooling," In Proceedings of the IEEE International Conference on Green Computing (IGCC 2012), San Jose, CA, USA (2012).
- C22. Harshad Bhagwat ; Amarendra Singh; "Limitations of current methodologies used for computational fluid dynamics (CFD) model development for pulverized coal based processes", Proceedings, XXVI International Mineral Processing Congress (IMPC 2012), Sep. 24-28, Paper No. 1070, pp. 05030-05040, New Delhi, India (2012).
- C21. Amarendra K Singh, Ravindra Pardeshi, and Sharad Goyal, Integrated Modeling of Tundish and Continuous Caster to Meet Quality Requirements of Cast Steels, In Proceedings of the 1st World Congress on Integrated Computational Materials Engineering (ICME), DOI: 10.1002/9781118147726.ch11, TMS(2011).
- C20. Ravindra Pardeshi, P. Dutta and A. K. Singh, Modeling of alloy solidification process for macrosegregation prediction, ASM International, M&MT, Mumbai (2011).
- C19. Umesh Singh, Amarendra K Singh, Parvez S and Anand Sivasubramaniam, "CFD-based Operational Thermal Efficiency Improvement of a Production Data Center", USENIX Conference on SustainableIT10, San Jose, CA, USA (2010).
- C18. R. Pardeshi, A. K. Singh and P. Dutta, "Modeling of Pb-40 wt% Sn solidification using explicit,

- implicit scheme", Proceedings of the 20th National and 9th ISHMT-ASME Heat and Mass Transfer Conference and 14th National Heat and Mass Transfer Conference, IIT Mumbai (2010).
- C17. Harshad Bhagwat and A. K. Singh, Utility of CFD based model for design and process optimization of pulverized coal combustion based processes, Asian Particle Technology, New Delhi, September 14-16 (2009).
- C16. Ravindra Pardeshi, Abhiram Murlidhar and A. K. Singh, "Modeling of Inclusion Particles in Tundish Vessel of Steelmaking Process", Asian Particle Technology, New Delhi, September 14-16 (2009).
- C15. A K Singh, Mathematical Modeling of Convection and Macroseggregation during Casting of Steel, Advances in Theory of Iron and Steel Making, Bangalore, December 9-11 (2009).
- C14. R. Pardeshi, A. K. Singh & P. Dutta, Simulation of Sedimentation in Alloy Solidification Using a Continuum Model, Proceedings of the 19th National and 8th ISHMT-ASME Heat and Mass Transfer Conference and 14th National Heat and Mass Transfer Conference, JNTU Hyderabad, (2008), Paper No. 317.
- C13. A K Singh, "Design and Productivity Solutions through Mathematical Modelling of Casting Operations", National Conference on Modern Trends in Aluminum Casting Technologies, IIM Angul Chapter, NALCO, Orissa, April 14-15 (2007), pp 47-53.
- C12. K. P. Nishad and A. K. Singh, Modeling of Mold Filling of Aluminum Casting, Proc. Sohn International Symposium on Advanced Processing of Metals and Materials: Principles, Technologies and Industrial Practice, Eds. F Kongoli and R G Reddy (2006), Vol. 4, pp. 263-270.
- C11. A K Singh, B. Basu and A. Ghosh, Influence of Natural Convection on Macroseggregation, Asia Steel International Conference, Jamshedpur, V. 2 (2003), pp.2.f.4.1-2.f.4.6.
- C10. B Basu, A K Singh and R Pardeshi: Numerical modeling of double-diffusive convection and macroseggregation during solidification of binary mixtures, International Symposium on Recent Trends in Heat and Mass Transfer during January 6-8, 2002.
- C9. A K Singh, B. Basu and A. Ghosh: Convection and Macroseggregation During Solidification of Alloys, Proceedings of International Conference on Solidification Processing, Oxford and IBH Publishing Co. Pvt Ltd., New Delhi, February 18-21 (2001), pp. 261-272.
- C8. B Basu, R Pardeshi, and A K Singh: Mathematical modeling of transport phenomena during solidification processing, Proceedings of the National Conference on Computational Materials science (NCCMS-2000), MRSI, Mumbai, India, (July 2000), pp. 18.
- C7. S. Basak, A. K. Singh, and B. Basu, Development of a two-phase model to simulate solidification phenomenon in low melting binary systems, Proceedings of the 4th ISHMT-ASME Heat and Mass Transfer Conference and 15th National Heat and Mass Transfer Conference, IAT/TRDDC Pune, 12-14 January, 2000, Loknath, M S, Venkateshan, S P, Prasad, B V S S S., Basu, B., and Prasad V. (Eds), Tata McGraw Hill, New Delhi, (2000), pp. 189-194.
- C6. R. Pardeshi, A. K. Singh and B. Basu, Effect of various mush models on macroseggregation in Pb-Sn alloy solidification, Proceedings of the 4th ISHMT-ASME Heat and Mass Transfer Conference and 15th National Heat and Mass Transfer Conference, IAT/TRDDC Pune, 12-14 January, 2000, Loknath, M S, Venkateshan, S P, Prasad, B V S S S., Basu, B., and Prasad V. (Eds), Tata McGraw Hill, New Delhi, (2000), pp.213-218.
- C5. A K Singh, S. Basak and B. Basu, Effect of orientation on double-diffusive convection and macroseggregation during solidification of binary alloys in a square cavity, Proceedings of the 4th ISHMT-ASME Heat and Mass Transfer Conference and 15th National Heat and Mass Transfer Conference, IAT/TRDDC Pune, 12-14 January, 2000, Loknath, M S, Venkateshan, S P, Prasad, B V S S S., Basu, B., and Prasad V. (Eds), Tata McGraw Hill, New Delhi, (2000), pp. 225-230.
- C4. A.K. Singh and B. Basu., N. Ramachandran, M. K. Farook, A. B. Kumar, "Simulation of tube annealing furnace", Proceedings of the Third ISHMT-ASME Heat and Mass Transfer Conference and 14th National Heat and Mass Transfer Conference, IIT Kanpur, 29-31 December, 1997, Biswas, G., Murthy, S.S., Muralidhar, K. and Dhir, V.K.(Eds), Narosa

Publishing House, New Delhi, (1998), pp. 809-814.

- C3. A.K. Singh and B. Basu, "Mathematical modelling of macrosegregation of iron-carbon alloy: Effect of key process and physical parameters", Proceedings of the Third ISHMT-ASME Heat and Mass Transfer Conference and 14th National Heat and Mass Transfer Conference, IIT Kanpur, 29-31 December, 1997, Biswas, G., Murthy,S.S., Muralidhar, K. and Dhir, V.K.(Eds), Narosa Publishing House, New Delhi, (1998), pp.925-930.
- C2. B Basu and A. K. Singh, " Role and characterisation of double-diffusive convection during solidification of binary alloys", Proceedings of the Third ISHMT-ASME Heat and Mass Transfer Conference and 14th National Heat and Mass Transfer Conference, IIT Kanpur, 29-31 December, 1997, Biswas, G., Murthy,S.S., Muralidhar, K. and Dhir, V.K.(Eds), Narosa Publishing House, New Delhi (1998),pp.129-141.
- C1. A.K. Singh and B. Basu, "Role of double-diffusive convection during solidification", invited Lecture in the Int. Workshop on Solidification, RRL, Trivandrum, India (1996), pp. 28-78.

#### Patents (Filed and granted)

1. Harshad Bhagwat, Amarendra Kumar Singh, Anand Sivasubramaniam, "Method and system for thermal management by quantitative determination of cooling characteristics of data center", Indian patent application, March 09, 2011, 652/MUM/2011, US Patent No. 89,49,091 B2, issued February 3, 2015.Granted
2. Harshad Bhagwat, Amarendra Kumar Singh, Sankaranaryanan D, Rajesh Jayaprakash, Anand Sivasubramaniam, A method and system for real time monitoring, prediction, analysis and display of temperatures for effective thermal management in a data center, Indian patent application, December 14, 2011, 3524/MUM/2011, US PatentUS9295183 B2, March 22, 2016,Granted
3. Umesh Singh, Amarendra Kumar Singh, Anand Sivasubramaniam, A method and system for efficient determining and implementing a viable containment design of a data center, Indian patent application, May 18, 2012, 1527/MUM/2012, PCT application, March 22, 2013, PCT/IN2013/000191; US patent application, November 18, 2014, US 14/401,978; EU patent application, November 17, 2014, EU 13791656.5; Aus patent application, November 11, 2014, AU 2013261006 Granted
4. Umesh Singh, Amarendra Kumar Singh, Anand Sivasubramaniam, Optimization for cooling, Indian patent application, September 03, 2011, 2459/MUM/2011, PCT Application, August 29, 2012, PCT/IN2012/000573; EU patent application, March 20, 2014, EP12816527.1; Aus patent application, March 20, 2014, AU 2012317170, US Patent No. US 9,740,801 B2, issued Aug. 22, 2017.Granted
5. Amarendra K Singh, Harshad Bhagwat, Umesh Singh, Rohan Amarnath, Anand Sivasubramaniam, A method for efficient designing and operating cooling infrastructure in a data center, Indian patent application, September 12, 2012, 2643/MUM/2012, PCT application, March 20, 2013, PCT/IN2013/000185, US Patent No: US 9, 959,371 B2, issued May 1 , 2018, Granted
6. Umesh Singh, Harshad Bhagwat, Sankaranarayanan D, Arun Varghese, Amarendra K Singh, Rajesh Jayaprakash, Anand Sivasubramaniam, System and method for facilitating optimization of cooling efficiency of a data center, Indian patent application, November 29, 2013,3758/MUM/2013
7. Umesh Singh, Amarendra K Singh, Anand Sivasubramaniam, System and method for facilitating homogenized distribution of airflow in a data center, Indian patent application, January 23, 2015,246/MUM/2015
8. Harshad Bhagwat, Amarendra Kumar Singh, Sankaranaryanan D, Rajesh Jayaprakash, Anand Sivasubramaniam , A method and system for cooling optimization of a data center, Indian patent application, February 21, 2012, 465/MUM/2012, PCT application, February 19, 2013,PCT/IN2013/000104
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