

Curriculum Vitae of Dr. N. K. S. Rajan

Name: Prof. N. K. S. Rajan

Occupational Address: Chief Research Scientist
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Personal Information:

Father's Name: N. S. Krishna Iyengar
Date of Birth: October 14, 1954
Place of Birth: Nagamangala, Karnataka, India
Marital Status: Married

Academic Qualifications: Ph.D. in Faculty of Engineering (Aerospace Engg.), IISc (1990)
B.E. in Mechanical Engg., Univ. of Mysore (1979), I Class

Experience: Chief Research Scientist, Aerospace Dept., IISc, 2013 and onwards
Principal Research Scientist, Aerospace Dept., IISc: 2002-2013
Senior Scientific Officer, Aerospace Dept., IISc: 1993-2002
Research Associate: 1990-92;

Fields of Research: Combustion; Heat Transfer; Fluid Dynamics (Experimental and Computational); Biomass Gasification; Renewable Energy; Advanced CFD Simulations, Instrumentation; Numerical Modelling (Analysis and Simulation); RSD Analysis, GIS Application Development; Advanced Application Software Development

Experience: More than 25 years of Academic Research and R&D in sponsored projects (Government Sponsored & Industrial Consultancy).
Has been expert member of several committees of the Institute and outside in Governmental and Autonomous Institutions.

R&D Projects: Principal Investigator for 30 Sponsored R&D projects and Co-Investigator of about 10 other R&D projects with a total of operating projects outlay of about Rs.75 Crores.

Academic Guidance: Research: 18 PhD (10 completed); 5 MSc (Engg) (2 completed); Academic Projects: More than 150 ME/MTech; Several batches of B.E. (dissertation projects for their degree)

Patents and Awards: 14 Patents in India and abroad with myself as one of the inventors;
4 Group Awards of National Level: FICII, 2004-05; CII-2007 and Nina Saxena 2011 – IITKG for excellence in Technologies in Biomass Energy; AREAS Foundation Day Award for excellent performance in the field of Biomass Gasification, August, 2015.

Publications	About 120 Research Publications (80 in International Journals and Conferences and 40 National Conferences); 14 Patents; 8 Internal Technical (Departmental) Reports.
Activities of Social Relevance	<p>Development of technologies in renewable energy and licenced it for entrepreneurs for commercialization that is currently saving a millions of litres of fossil fuel.</p> <p>Have been on the board of studies of many engineering colleges to advice on the curriculum of their college.</p> <p>Has been a member of trustees of a charitable institution Chidambarashram, Gubbi that is supporting poor children for their education and get them exposed to Vedic culture.</p>

Synopsis of Research Work:

The research activities of the work documented involves multiple areas focused largely on Combustion, Fluid Dynamics, Biomass Gasification and allied areas. Extensions to different areas including electronic instrumentation, HPC and chemical engineering in addressing some of the problems of high industrial relevance are driven by common themes and are threads of the research topics.

Some of the disciplines covered include both experimental and computations aspects of the area covering – fluid dynamics, heat transfer, combustion, gasification based energy, engine research, electronic instrumentation and control designs and computer software and hardware engineering.

Most of these research activities are oriented largely in addressing problems of direct practical or industrial relevance, and are of other scientifically challenging situations picked up during activities of developing new technologies. This approach has allowed for handling of large R&D projects, managing of a large scientific support team and related aspects that has resulted in significant overall contribution. The set of publications and the larger projects handled and the patents held on the technology developed provide a fair measure of the contributions and involvements.

Some of the research work carried out could be tagged with the following steams of activities indicated below.

- This focuses on computer simulation of fluid flows. Starting from the beginning of the academic carrier when the area of CFD was not developed, had written own code for a flow solver (RANS NS solver) used for his thesis. Further activities have taken a leap in CFD with solution oriented CFD using both industry standard commercial codes and in-house development of codes and algorithm enhancements for CFD. Several PhD students under my guidance have completed their thesis work on this stream of activity.
- Extensive basic and industrial research on Biomass Gasification and Bio-Energy. Many core concepts of the research have been pursued beyond leading it to a industrially applicably technology and with all of them patented and commercialized successfully. Biomass Gasification is one of pioneering stream of work that was initiated by Prof. Mukunda in early 90s and having been a faculty from then, have been extensively involved in the R&D activities in this area. Three students of mine have completed their PhD in this area and one is pursuing now and is in advanced stage of completion. In the Bio-Energy sector, a new concept of high

quality scrubber for H₂S from biogas from industrial ETPs has made a breakthrough in this area and is in extensive industrial application recently. Extraction of Silica from rice husk ash, that had a disposal issues in the industries have led to generation of high quality Silica of internationally well accepted standards with good value addition and now the technology is commercially getting established. Consequent to the expertise of this, MNRE has sponsored many major projects in this area and a project for core support

- Development of specialized test rigs and experimental setups for studying complex problems is one of the core competences picked during the career at the Institute. Much like CFD activities, this was concurrently pursued from the beginning of the career at the Institute, right from being as a student and continued strongly all along further that have contributed in taking the research concepts to industrially standard technologies.
- The experimental work taken up have been generally made to be complementary studies to the simulation work and are optimally selected to be the configurations derived from CFD simulations and are built with a focus on testing, validating and for parametric evaluation and for obtaining the results that are taken as feedback in comparison and to be continued in simulations that provide a comprehensive insight to the problems addressed.
- The hardware built for the experiments would most often been custom fabrications and special equipment that are modified to meet special measurements. To incorporate more unique measurements and instrumentations, the required systems have been built in-house where the commercial systems are not available or far too expensive.
- In past decade that received many major core funding R&D projects, training support for engineering students have been provided largely for ME degree dissertation projects. The students approaching for such projects with appropriate background have been involved in a range of such experimental research. Consistently over past 15 years, more than 100 M.E. students from the streams of Mechanical, Energy, Aerospace, Electronics and Instrumentation have completed their dissertation research project under guidance. This activity is carried as additional to the normal activity of the normal departmental activities, for the guidance of students for research conferment.
- The research profile is acknowledged in terms of adequate publications, patents, sizeable large R&D projects, awards of distinction and a set of research students and all these sectors have received positive feedback and record of good technical performance.

Recent (a decade) Publications:

1. Afroz Javed, N.K.S. Rajan, Debasis Chakraborty, Effect of side confining walls on the growth rate of compressible mixing layers, *Computers & Fluids* 86 (2013) 500–509.
2. S. Varunkumar, N. K. S. Rajan, H. S. Mukunda - Single Particle and Packed Bed Combustion in Modern Gasifier Stoves - Density Effects, *Combustion Science and Technology (CST)*, 183: pp 1147–1163, October, 2011.
3. Anil N., Rajan N. K. S. and Deshpande S. M. - Modified Kinetic Flux Vector Splitting (M-KFVS) method for compressible flows. *Computers and Fluids*, vol. 48, no. 1, pp. 137-149, 2011.

4. Aditya P Kulkarni and Rajan N K S, Development of a Cost Effective and Reliable Flame-Out Protection Unit for Combustion Devices, Journal of Instrument Society of India, IISN:0970-9983, Vol 41 N1, pp 16-19, March, 2011.
5. S. Varunkumar, N. K. S. Rajan, H. S. Mukunda - Experimental and Computational Studies on a Gasifier Based Stove, Energy Conversion and Management, Vol 53 (2011) pp 135–141, 2012.
6. S Varunkumar, N K S Rajan and H S Mukunda - Single particle and packed bed combustion in modern gasifier stoves -density effects. Combustion Science and Technology, 183(11):1147-1163, 2011.
7. Afroz Javed, NKS Rajan and Debasis Chakraborty - Behaviour of Turbulent Prandtl / Schmidt Number in Compressible Mixing Layer” under review in Journal of Propulsion and Power.
8. Afroz Javed, P.J. Paul, NKS Rajan and Debasis Chakraborty - "Exploration of supersonic confined Mixing Layer – Effect of dissimilar gases at different temperatures", under review in Journal of Aerospace Engineering.
9. BijuKumar K S, P Balachandran, N K S Rajan, P J Paul, Role of Hydrogen Injection Temperature on the Combustion Instability of Cryogenic Rocket Engines”, Journal of Propulsion and Power, October, 2011.
10. S. Dasappa, P. J. Paul, N. K. S. Rajan, H. S. Mukunda, G. Sridhar, H. V. Sridhar - Biomass gasification technology – a route to meet energy needs; Current Science; Vol. 87, No. 7, ; pp 908 – 916, 2004.
11. G. Sridhar, H. V. Sridhar, S. Dasappa, P. J. Paul, N. K. S. Rajan and H. S. Mukunda - Development of Producer Gas Engines, Journal of Automobile Engineering, Part D, Proc. Instn. Mech Engrs, Vol. 219, pp 423-438, 2005.
12. G. S. Sheshagiri, N. K. S. Rajan and H. S. Mukunda, CGPL, assessment of Biomass resource and its power potential using remote sensing data for Karnataka state and the nation in general, MGRIFED Journal Vol-1 Issue No. 1, March-2007.
13. Konark Arora, N. K. S. Rajan and S. M. Deshpande, Weighted Least Squares Kinetic Upwind Method (WLSKUM) for computation of flow through blade passage with Kinetic Periodic Boundary Condition (KPBC), Computational Fluid Dynamics Journal, Vol 16, No. 3:31, 2008, pp: 300-319.
14. T. R. Anil, P. G. Tewari and N. K. S. Rajan, Analysis and Optimal Design of a Producer Carburetor, International Journal of Applied Engineering Research, Vol 4, No.7, pp 1125-1138, 2009.
15. Anil N., Rajan N. K. S. and Deshpande S. M. Optimal Control of Numerical Dissipation in M-KFVS Method for Compressible Flows, Computational Fluid Dynamics Journal, Vol. 18, no. 1, pp. 139-153, 2009.
16. H. S. Mukunda, S. Dasappa, P. J. Paul, N. K. S. Rajan, Mahesh Yagnaraman, D. Ravi Kumar, Mukunda Deogaonkar - Gasifier stoves- Science, technology and field Outreach, Current Science, Vol. 98, No. 5, 10 March, 2010.

17. S. Varunkumar, N. K. S. Rajan - A Study of Mixing and Combustion with Multiple Transverse Oxidizer Jets and a Single Fuel Jet in Cross Flow, Proceedings International Conference & Exhibition, ICEAE 2009, IISc-Bangalore, May 18-22, 2009.
18. G. S. Sheshagiri, N. K. S. Rajan, S. Dasappa, P. J. Paul, Agro Residue Mapping for India, 17th European Biomass Conference, Hamburg, Germany, 29 June -July 3, 2009.
19. J. S. Pradeep, S. D. Ravi, Pravin Honguntikar and N. K. S. Rajan, CFD Analysis of Non-Reacting Flow in a Reciprocating Engine during Complete Cycle with Undisturbed and Stable Moving Grid. 11th Annual CFD Symposium, August 11-12, 2009, Bangalore.
20. Bijja Sunil Deol, S. D. Ravi, and N. K. S. Rajan, Experimental and CFD Analysis of Peak Energy Estimate in a Typical Calandria Based Reactor. Proc. of the International Conference on Advances in Mechanical Engineering, Surat, India, August 3-5, 2009.
21. Afsar Ahmed Waddinakatti, Bijja Sunil Deol, Ravi S. D, J. Shivkumar and N. K. S. Rajan, Experimental and CFD Analysis of Carburetor for Producer Gas Application, 21st National Conference on IC Engines & Combustion, Davangere, India, December 10-12, 2009.
22. S D Ravi, P S Kulkarni and N K S Rajan, A Numerical Study of Diffuser Performance of Gas Dynamic Laser System. International Conference of Computational Fluid Dynamics (ICCFD6), St. Petersburg, Russia 12-16, July, 2010.
23. Mula Venkata Ramana Reddy, S D Ravi, P S Kulkarni and N K S Rajan, Numerical Model for the analysis of the Thermal-Hydraulic Behaviors in the Calandria Based Reactor, International Conference of Computational Fluid Dynamics (ICCFD6), St. Petersburg, Russia, July 12-16, 2010.
24. Ananda Theertha, Santhosh, P. S. Kulkarni, N. K. S. Rajan, S. Vasantha Sastry - Preliminary Numerical Investigations of Viscous Flows Over Wing of a Transport Aircraft, 12th AeSI CFD Conference, August 11-12, 2010.
25. BijuKumar. K. S, Mathew George, V. Narayanan, P. Balachandran, N. K. S. Rajan, P. J. Paul, Numerical Simulation of High Frequency Combustion Instability in Cryogenic Engines, National Conference on Expanding Frontiers in Propulsion Technology (ASET 2011), June 17-18, 2011. (Awarded as Best Paper of the Conference)
26. Aditya P Kulkarni and Rajan N K S, A Precision High Speed AC Power Monitoring Device for Power Regulation and Control, International Conference on Circuits and Systems, WCECS 2011 (World Congress on Engineering and Computer Science 2011), Univ of Berkeley, ISBN: 978-988-19251-7-6, ISSN: 2078-0958, Vol II, pp 748-752, October 19-21, 2011.
27. S D Ravi, N K S Rajan. P S Kulkarni. CFD Analysis of Complex Flow through Multiple Nozzle Driven Aerodynamic Laser Cavity. National Conference on Recent Trends in Mechanical Engineering Science, Tumkur, Karnataka, India, RTIMES-2007,.
28. Konark Arora, N. K. S. Rajan and S. M. Deshpande, On the Order of Accuracy of Gridfree Methods using Defect Correction with Inner Iterations, 7th ACFD Conference, November 26-29, 2007.

29. Konark Arora, N. K. S. Rajan and S. M. Deshpande, Kinetic Least Squares Meshless Method using Eigendirections, 4th International Workshop on Meshfree Methods for Partial Differential Equations, Bonn, Germany, September 17-20, 2007.
30. Anil N., Rajan N. K. S., Omesh Reshi and Deshpande S. M. Adjoint based optimal control of dissipation in kinetic schemes. In Proceedings of the 7th Asian Computational Fluid Dynamics Conference (ACFD), Bangalore, India, Nov 26-30, 2007.
31. Anil N., Rajan N. K. S., Omesh Reshi and Deshpande S. M. M-KFVS method combined with optimal control of dissipation. In Proceedings of the Institute for Computational Fluid Dynamics (ICFD) Conference on Numerical Methods for Fluid Dynamics, Reading, UK, March 26-29, 2007.
32. BijuKumar. K. S, P.Balachandran, P. J. Paul, N. K. S. Rajan – Numerical Modeling of Combustion Process in a LOX-GH₂ Cryogenic Engine, Proceedings of International Conference and XX National Conference on IC Engines and Combustion (ICONICE-07), December 6-9, 2007.
33. S D Ravi, N K S Rajan, P S Kulkarni. Computational and Experimental Studies of Fluid Flow and Heat Transfer in a Calandria Based Reactor. The Fifth International Conference on Computational Fluid Dynamics, Seoul, Korea, July 7-11, 2008.
34. Anil N., Rajan N. K. S., Omesh Reshi and Deshpande S. M., A low dissipative discrete adjoint m-KFVS method, Proceedings of the 5th International Conference on Computational Fluid Dynamics Conference (ICCFD), Seoul, Korea, July 7-11, 2008.
35. Konark Arora, N.K.S. Rajan and S.M. Deshpande, On the Robustness and Accuracy of Least Squares Kinetic Upwind Method (LSKUM), 12th Asian Congress of Fluid Mechanics (ACFM), Daejeon, Korea, August 18-21, 2008.
36. S D Ravi, N K S Rajan. P S Kulkarni. CFD Based Design Optimizations of the Diffuser of a Gas Dynamically Driven Laser Cavity. *Symposium of CFD Division of the Aeronautical Society of India (AeSI)*, NAL, Bangalore, India. 11-12 August 2008.
37. S D Ravi, N K S Rajan. P S Kulkarni. Computational and Experimental Studies of Fluid Flow and Heat Transfer in a Calandria Based Reactor. *Symposium on CFD Division of the Aeronautical Society of India (AeSI)*, NAL, Bangalore, India. 11-12 August 2008.
38. M H Dinesh, S D Ravi, N K S Rajan. Limiting Thermal Dissipation in a Typical Calandria Based Nuclear Reactor. International Conference on Advances in Mechanical Engineering, S. V. National Institute of Technology, Surat, India, December 15-17, 2008.
39. S S Vinay, S D Ravi, N K S Rajan. Numerical and Experimental Modeling of Producer Gas Carburetor, International Conference on Advances in Mechanical Engineering, S. V. National Institute of Technology, Surat, India, December 15-17, 2008.
40. H. V. Sridhar, N. K. S. Rajan, S. M. Shashidhara and K. Ramakrishnan, Characterization of Turbocharger Compressor for Engines with Producer Gas as Fuel, International Conference Pondicherry, January, 2009. (Awarded as Best Paper of the Conference)
41. S D Ravi, M A Sriram, P S Kulkarni and N K S Rajan, A CFD Study of Diffuser Performance of Gas Dynamic Laser System, Proceedings of International Conference & Exhibition, ICEAE 2009, IISc, May

18–22, 2009.

42. H. V. Sridhar, G. Sridhar, S. Dasappa, N. K. S. Rajan, P. J. Paul, H. S. Mukunda, Field Experience of IISc Gasification Systems, Proceeding of the Seminar on Biomass Gasifiers, Rubber Board, Kottayam, 2003.
43. H. V. Sridhar, G. Sridhar, S. Dasappa, N. K. S. Rajan, P. J. Paul, H. S. Mukunda, Experience on use of biomass gasifiers in crumb rubber industries, Proceedings of the National Conference on Advances in Mechanical Engineering, Shimoga, Karnataka; February 12-14, 2004.
44. G. Sridhar, S. Dasappa, H. V. Sridhar, P. J. Paul and N. K. S. Rajan, Gaseous Emissions Using Producer Gas Fuel in Reciprocating Engines, paper no. 2005-01-1732, SAE centenary conference held at Detroit, April 2005.
45. Sumer B. Dirbude, G. S. Sheshagiri, N. K. S. Rajan - Experimental Analysis of Feedback Control System for Lambda Sensor Based Producer -Gas Engine Carburetor, National Conference, Ghousia College of Engineering, VTU, 2005
46. N. K. S. Rajan, Dr. P. G. Tewari and T. R. Anil, An Approach for Designing of Producer Gas Carburetor for Application in Biomass based Power Generation Plants, NATCON Mechanical Engineering, 2005.
47. H. V. Sridhar, G. Sridhar, S. Dasappa, P. J. Paul, N. K. S. Rajan, K Ramakrishnan, Adaptation and Performance Evaluation of Stationary SI Engines for Producer Gas Applications, ICAC 2005, pp. 485 – 489, June 13-16, 2005.
48. Konark Arora, N. K. S. Rajan and S. M. Deshpande, Weighted Least Squares Kinetic Upwind Method (WLSKUM) using Eigenvector Basis, 8th Annual CFD Symposium", organized by CFD Division of AeSI, Bangalore, August 11-13, 2005.
49. Anil N., Rajan N. K. S. and Deshpande S. M. Modified KFVS (m-KFVS) method with velocity dependent dissipation control function, Proceedings of the 8th AeSI CFD Symposium, August 11-13, 2005.
50. G. Sridhar, H. V. Sridhar, S. Dasappa, P. J. Paul, D. N. Subbukrishna and N. K. S. Rajan, Sudarshan Kumar And H. S. Mukunda - Green Electricity from Biomass Fuelled Producer Gas Engine, Proceedings of 14th European Biomass Conference and Exhibition, 17-21 October, 2005.
51. Konark Arora, N. K. S. Rajan and S. M. Deshpande, Weighted Least Squares Kinetic Upwind Method (WLSKUM) for computation of flow through blade passage with Kinetic Periodic Boundary Condition (KPBC), SAROD-2005, December 7 -9, 2005.
52. T R Anil, S D Ravi, M Shashikanth, P G Tewari, and N K S Rajan, CFD Analysis of a Mixture Flow in a Producer Gas Carburettor. International Conference on Computational Fluid Dynamics, Acoustics, Heat Transfer and Electromagnetics CFEMATCON-06, July 24-25, 2006, Andhra University, Visakhapatnam, India.
53. M Shashikanth, S D Ravi, N K S Rajan. CFD analysis of Fluid flow and Heat Transfer in a Calandria Based Reactor Validated with experimental results. ANSYS India, 2006.

54. T R Anil, S D Ravi, M Shashikanth, P. G. Tewari and N K S Rajan. CFD Analysis of a Mixture Flow in a Producer Gas Carburettor for Optimizing the Design Configuration. ANSYS India, 2006..
55. M. A. Sriram, N. K. S. Rajan and P. S. Kulkarni. Computational Analysis of Flow through a Multiple Nozzle Driven Laser Cavity and Diffuser, Proceedings of Fourth ICCFD 2006, Belgium, pp 759-764, July 10-14, 2006.
56. P. Rajeshwari, B. K. Ashwini Kumar, G. S. Sheshagiri, N. K. S. Rajan - A Method of Using Influencing Parameters by GIS based Intersections for Obtaining a Cost Effective Biomass Assessment using RSD. Map India, New Delhi, 2006.
57. N. Balasubramanya Raju, B. Sunil, Inamdar, G. S. Sheshagiri, N. K. S. Rajan - A Fast Method for Obtaining Spatial Distribution of a Variant Using Dendrograms of its Influencing Parameters using RSD, Map India, New Delhi, 2006.
58. G. S. Sheshagiri, M. Dhinasekar, D. R. Anantha Deshpande, N. K. S. Rajan - A Study on Spatial Distribution of Biomass Resources Using RSD, Map India, New Delhi, 2006
59. D. N. Subbukrishna, S. Dasappa, P. J. Paul and N. K. S. Rajan - Hydrogen Sulfide removal from biogas by ISET process, Proceedings Of 14th European Biomass Conference and Exhibition, Biomass for energy, Industry and climate Protection, Map India, New Delhi, 2006
60. D. R. Anantha Deshpande, Dhinasekar, G. S. Sheshagiri, N. K. S. Rajan - GIS based Web Enabling of Nationwide Biomass Digital Atlas with Data Compression, Int. J. Energy. Res. 25:1053-1072, Map India, New Delhi, 2006.
61. Konark Arora, N. K. S. Rajan and S. M. Deshpande, Application of Weighted Least Squares Kinetic Upwind Method using Eigendirections (WLSKUM-ED) to 3-D Flows, 9th Annual CFD Symposium, AeSI, August 11-12, 2006.
62. M. A. Sriram, N. K. S. Rajan, P. S. Kulkarni, "Complex Flow Analysis through a Multiple Nozzle Driven Laser Cavity", Symposium on Applied Aerodynamics and Design of Aerospace Vehicle (SAROD-2007) November 22-23, 2007.
63. S. Dasappa, G. Shridhar, H. V. Shridhar, N. K. S. Rajan, P. J. Paul and A. Upasani - Producer Gas Engine - Proponent of clean energy technology. 15th European Biomass Conference and Exhibition, May 7-11, 2007.
64. D. N. Subbukrishna, K. C. Suresh, P. J. Paul, S. Dasappa and N. K. S. Rajan - Precipitated Silica from Rice husk ash by IPSIT Process. 15th European Biomass Conference and Exhibition, May 7-11, 2007.
65. G. Sridhar, S. Dasappa, H. V. Sridhar, P. J. Paul and N. K. S. Rajan - Green Electricity ~ A Case Study of a Grid Linked Independent Power Producer. 15th European Biomass Conference and Exhibition, 7-11 May 2007

Reports and Books:

1. Anil N., Rajan N.K.S. and Deshpande S.M. Mathematical analysis of dissipation in m-KFVS method, Dept. Report 2005 FM 1, Dept. of Aerospace Engg., IISc, Bangalore, India, 2005.

2. Anil N., Rajan N.K.S. and Deshpande S.M. A finite volume method based on modified KFVS (m-KFVS) for 2D Euler equations. Report 2006 FM 1, Dept. of Aerospace Engg., IISc, Bangalore, India, 2006.
3. Co-author of the Book – Biomass to Energy, The Science and Technology of IISc Bio-energy Systems, published by ABETS, Indian Institute of Science, 2003.

Thesis titles of students guided and awarded with Ph.D.:

1. Weighted Least Squares Kinetic Upwind Method using Eigen Directions (WLSKUM-ED) by Konark Arora, PhD Degree of Engg. Faculty, IISc; Research Guides: N K S Rajan, S M Deshpande (JNCSAR), March, 2007.
2. Experimental and Numerical Studies on Biomass Gasification System – A New Technology Developed at IISc, With a Special Reference to Its Adaptation for a Commercially Available Gas Engine, by T R Anil, (work carried out at CGPL, IISc) PhD Degree awarded by Veswshwaraya Technological University, Belgaum; Research Guides: N K S Rajan, P G Tewari (BVBCET, Hubli), October, 2007.
3. Optimal Control of Dissipation in Kinetic Schemes, by Anil N, PhD Degree of Engg., Faculty, IISc;; Research Guides: N K S Rajan, S M Deshpande (JNCSAR), October, 2008.
4. Characterization and Matching of Turbochargers for Producer Gas Engine Applications– Experiments and Analysis - by H V Sridhar (work carried out at CGPL, IISc) PhD Degree awarded by Veswshwaraya Technological University, Belgaum, Research Guides: Rajan N K S, S M Shashidhara (SIT, Tumkur) and K Ramakrishan (SSNIT, Chennai), November, 2009.
5. Role of Hydrogen Injection Temperature on the Combustion Instability of Cryogenic Rocket Engine – by Biju Kumar (Ext. Registrant from VSSC), PhD Degree of Faculty of Engg., IISc; Research Guides: P J Paul, Rajan N K S, Balachandran, June, 2012.
6. Packed bed gasification-combustion in biomass based domestic stoves and combustion systems by S Varunkumar, PhD Degree of Faculty of Engg., IISc; Research Guide: Rajan N K S, September, 2012.
7. Compressible Mixing of Dissimilar Gases – by Afroz Javed (Ext. Registrant from DRDL); PhD Degree of Faculty of Engg., IISc, Research Guides: Rajan N K S, Debasis Chakraborty, September, 2013.
8. Understanding High Speed Mixing Layers with LES and Evolution of URANS Modelling – by Iyer Arvind Sundaram, PhD Degree of Faculty of Engg., IISc; Research Guide: Rajan N K S, June, 2014.
9. Experimental and computational studies on deaflagation-to-detonation transition and its effect on the performance of PDE - by Abhishek R Bhat, PhD Degree of Faculty of Engg., IISc; Research Guide: Rajan N K S, October, 2014.

Patents on the Technologies Developed:

The different technologies patented for licensing it for commercialization as provided in the table above are:

1. IISc Biomass Gasification System, in different countries [1, 3, 4, 5, 6, 7 & 8].
2. Charcoal generation with Gasification Process [9].

3. Removal of H₂S from biogas or sewage gas for use with power generation [10,20].
4. Efficient Biomass Cook-Stove [11].
5. Ejector based Biomass Stove at different power levels [12].
6. Extraction of high quality precipitated silica from rice husk ash, in different countries [13, 14, 15, 16, 17 & 18].
7. PG Carburetor [19].

List of the Patents and Design Registrations with me as an Inventor:

Title of the Patent	Country	Application No. / Date of filing	Patent No. & Date of Grant
4. Biomass Gasifier	Switzerland	1840/99 Oct. 8, 1999	Patent No.693929; April 30, 2004
5. A process & apparatus for cleaning tar & dust laden gas to highest purity - C ⁿ technology	India	742/Mas/2001 Sep. 7, 2001	Patent No. 215917, March 5, 2008
6. An Improved Biomass Gasifier	India	2273/Mas/98 Oct. 9, 1998	Patent No. : 217056 March 24, 2008
7. An Improved Biomass Gasifier	Japan	No.2002-41620 Feb. 19, 2002	Patent No. : 4805520 August 19, 2011
8. An Improved Biomass Gasifier	Brazil	No.PI0107342-7 Ref No. P112111 Aug. 24, 2001	Patent No.: PI0107342-7 September 6, 2011
9. An Improved Biomass Gasifier	Srilanka	No. 12235 Feb. 28, 2001	In process
10. An Improved Biomass Gasifier	Thailand	No. 71583 Feb. 5, 2002	In process
11. An Improved Biomass Gasifier	Europe	No.203833.9 Nov. 2, 2000	In process
12. Charcoal Generation with Gasification process	India	2246/CHE/2011 Jan. 7, 2011	Patent Application filed
13. A process of removing hydrogen sulfide from a gas mixture	India	No.1568/Mas/96 Aug 1996	Patent No. 193111 Dec. 29, 2005
14. Fuel Efficient Biomass Stove and a method of operating the Stove	India	1365/CHE/2005 Sep. 27, 2005	Patent No.229283 February 16, 2009

15. IISc Ejector induced Gasification stove – n kg/hr	India	No.3202/CHE/2008, Dec. 19, 2008	Request for examination filed in June 2011
16. A novel process and apparatus for the manufacture of precipitated silica from rice husk ash	India	No.134/MAS/2003 Feb. 18 , 2003	Patent No. 216477 Date of Grant: March 13, 2008
17. A novel process and apparatus for the manufacture of Precipitated Silica from Rice Husk Ash	China	200480005829.5 Feb, 18, 04	Patent No.: ZL 200480005829.5 June 25, 2008
18. A novel process and apparatus for the manufacture of Precipitated Silica from Rice Husk Ash	Indonesia	W-0020050220 18-Aug-05	Patent No.: ID P 0024190 Date of Grant: September 3, 2009
19. A novel process and apparatus for the manufacture of Precipitated Silica from Rice Husk Ash	Japan	2006-502649 Feb. 18, 2004	Patent No. 4537379 Date of Grant: June 25, 2010
20. A novel process and apparatus for the manufacture of precipitated silica from rice husk ash –	Thailand	No. 088822 Feb. 18, 2004 New Application No. 0401000537	Examination request filed in May 2010
21. A novel process and apparatus for the manufacture of Precipitated Silica from Rice Husk Ash	Vietnam	No. 1-2005-10301 Sep. 19, 2005	Response filed in July 2009
22. Producer Gas Carburetor	India	No. 659/CHE/2009 Nov. 3, 2009	PCT App - Oct. 2010 Req. for Examin-June, 2011
23. A Method For Removing Hydrogen Sulfide From A Gaseous Mixture	India	No. 2979/CHE/2015	In Process

Recently (a decade) undertaken Projects with my role as PI:

Sponsored (Grant-in-Aid) R&D Projects:

Title	Funding Agency	Value (₹ Lakhs)	Duration
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1. National Biomass Resource Assessment Program	MNES	120.0	Aug.2000- March 2007
2. Development of Low Emission Metal Melting Recuperative Furnace	KCTU	1.4	Apr 04 – Sept.04
3. CFD Analysis of Characterisation of Flow in Multiple Nozzle Driven Tunnel and Diffuser used as Laser Cavity	LASTEC, DRDO	9.5	Sept-04 – Feb 07
4. Strategic Development of Bio-energy – Phase II	MNES	168.0	Feb.05 – Jan 08
5. Storability of bamboo through the process of Torrifaction	NMBA	24.7	Sept.05 – May 06
6. Biomass mapping for power generation in selected states	MNRE	30.0	Oct 07-May 08
7. CFD Simulations and Estimation of Lateral Aerodynamic Coefficients over a Missile	DRDL	7.5	Mar 07 –Feb 09
8. Improvement of solution accuracy of existing KFVS codes using modified KFVS (m-KFVS) method	DRDL	3.3	Aug 08 – Feb 09
9. Advanced RDF Gasification Systems	MNRE	283.2	Oct 08 – Oct 2014
10. CFD Code Comparison	ARDB	6.5	Oct 08 - Dec 09
11. Hydrogen and Liquid Fuels from Biomass Gasification	MNRE	209.6	Oct 2009 – Sept 2012
12. Experimental and Numerical Investigations of Viscous Flow over Complete Aircraft	Bombardier Aircraft, Canada	110.0	Oct 2009 – Oct 2012
13. Advanced Biomass Research Centre	MNRE	984.0	Apr 2009 – Apr 2014
14. Biomass Resource Map of India	MNRE	144.0	Jan 2010 – Apr 2014
15. Development of Pulse Detonation Engine (PDE)	CARS, DRDL	70.0	June, 2011 – Apr, 2014
16. Combustion Instabilities in Solid Rocket Motors	CARS, DRDL	9.7	Sep., 2013 – Mar, 2015

17. Jain University - Development of non-combustibility tester	Jain University	0.7	May 2011 – Dec 2013
Total Outlay of the Research Projects (₹ Crores)		21.82	

Industrial Consultancy Projects:

Title	Funding Agency	Value (₹ Lakhs)	Duration
1. UNIDO assignment on renewable energy entrepreneurship development in Zambia, Cuba, Brazil	UNIDO	18.0	Oct 03 – Dec 06
2. Development of detailed feasibility reports for the units in North East	NMBA	15.0	Nov.03 – Feb .04
3. Development of detailed feasibility reports for the units in North East	NMBA	15.0	Dec 03- Dec 04
4. Detailed feasibility study on Biomass power project for HPCL in Nagapattinam district	HPCL	2.7	Mar 05 – Dec05
5. Technical Support for the gasifier at HPC	HPCL	3.5	July 05 – Jun 06
6. Tech. support for implementation of Narayani-Shanker Biomass Power Plant (600KWe) in Nepal	TMB Energietech nic Nepal	12.0	Sept.09 – Dec 2011
Total Outlay of Consultancy Projects (₹ Lakhs)		66.2	

Industrial R&D Projects:

Title	Industrial Agency	Value (₹ Lakhs)	Duration
1. Demonstration of 20kwe Gasifier at CNPq-Brazil	CNPq-Brazil	18.5	Nov 01 – Jan 2003
2. Brazil-Biomass Users Network- Brazil Gasifier	Brazil	16.5	Jun 02 – June 2003

3. Facilitating infrastructure at H-Nagar and Hosahalli Gasifier units	BERI	4.0	July 03- Sept. 05
4. Demonstration of Gasifier unit for University of Amazonas, Brazil	University of Amazonas, Brazil	4.5	July 03- Oct 03
5. Development of stoves for puffed rice preparation	KCTU	2.8	July 03 – Dec 03
6. Biomass demo. power projects at Bethmangla & Kushalnagar	KPCL	281.6	Aug 03- Dec 05
7. Demonstration of 75 kg/hr Biomass Gasifier	JNCE, Shimoga	21.5	Oct. 03- Mar 04
8. Demonstration of two gasifier units of 1 kg/hr for NMBA	NMBA	5.0	Jan 04 – Dec 04
9. Demonstration of 20 kWe Gasifier at University of Cidade, Joao Pessoa, Brazil	University of Cidade	17.5	Sept. 04 – Dec 04
10. Demonstration of two gasifier units of 5kg/hr at mountain division of the Indian army	NMBA	15.5	Dec 04 - May 05
11. Demonstration of 1 kg/hr Biomass Gasifier at Vienna and Zambia	UNIDO	4.0	Feb 05 – July 05
12. Demonstration of 100 kWe bamboo based gasifier for Indian army at Along	NMBA	52.5	Feb 05 – July 05
13. Demonstration of 1 kg/hr Biomass Gasifier	Synergy Renewable Energy, Kolkata	2.4	Jun 05 – Oct 05
14. Design of Carburetor, gas regulator suitable for Cummins Gas engine	BTIT Engg. Kolkata	1.7	Sept.05 – Nov.05
15. Demonstration of 35 kg/hr biomass gasifier with 100% producer engine at Guwahati	NMBA	14.8	Dec-05 - May 06
16. Prototype testing of Stoves	BP Energy India	5.0	Jan 06 – Dec 06
17. Prototype testing of Stoves	BP Energy India	5.0	Jan 06 – Dec 06
18. Demonstration of 90kg/hr Gasifier system	NMBA	41.5	Feb 06 – Mar 07

19. Demonstration of 35 kg/hr biomass Gasifier with 100% PG engine for Army in Manipur	NMBA	14.8	May 06 - Dec 06
20. Demonstration of 1 kg/hr Biomass Gasifier at Agartala	NMBA	4.0	Sept 06- Dec 06
21. Demonstration - 70 kg/hr Biomass Gasifier at Cocodrilo, Cuba	UNIDO	45.0	Dec 06 – May 07
22. Development of Bamboo Slicing machine	NMBA	11.0	Nov.06 – Mar 07
23. Demonstration of 35 kg/hr Biomass Gasifier plant at Ndola, Zambia	UNIDO	42.0	Jun 07 - Dec 09
24. Demonstration of 680kg/hr Gasification system for Charcoal production	Filtrex Technologies	67.5	Oct 07 – Sept 08
25. Exp & Num Investigation of Viscous Flow over Complete Aircraft	Bombardier Aircraft, Canada	110.0	Oct 2009 – Oct 2012
26. Implementation of 70 kWe Gasification System at Florence University, Italy	Florence University & MNRE	145.0	May 10 - Dec 2011
27. Demonstration of 35 kg/hr Biomass Gasifier Systems in Benin and Nigeria	UNIDO	130.0	June 11 – May 2012
Total Outlay of Industrial Projects (₹ Crores)		10.84	

Overview Technical Committees/Services Provided:

The laboratory CGPL – Combustion, Gasification & Propulsion Laboratory was established in 80's and before this, it was called "Rocket Test House" that was used for static tests of rocket motors and the lab was called Combustion and Propulsion Lab, when I joined the lab with my career as a student at the Institute. Building up of facilities with limited resources and funds such as experimental setups, infrastructure like buildings and augmentations for test facilities - have been one of the regular part of my activities and most often have been the peer heading these activities, including in the current day activities.

I have worked in many committees of the IISc appointed by the Director and. Apart from several short (single or few sittings) duration committees and senate nominations (for research students examination), purchase committees, telephone advisory committee and a few others, two long-term committees I have served include Committee for awarding Rate Contract for computers and peripherals and Committee for Computerization of Administration. I am on the Board of Studies to two Colleges of Higher studies (now Deemed Universities) BVB-Hubli and MSRIRAS, Bangalore. I am on Board of Director (nominated by the Institute) for M/s Usher Agro/Eco Power, Mathura who are our exclusive licensees for the technology on generation of Silica from RHA.

Awards and Recognitions:

The following group awards have been received where I am one of the prime persons cited.

1. FICCI (Federation of Indian Chambers of Commerce & Industry) Annual Award 2004-2005, in recognition of Research in Science and Technology.

The award was in recognition of our group in spearheading the development of biomass combustion and gasification for several years, with dedication. The citation continues to add that "The open-top re-burn, downdraft gasification system, developed by the society is a significant contribution to modern technology in the field of renewable energy." The award was given away by the Prime Minister of India.

2. CII (Confederation of Indian Industry) – National Award for Excellence in Energy Management 2007 in recognition of Innovative Energy Saving Product.

The award was tagged to the collaborative work of Cummins and ABETS had in providing a new product line of gas engines for producer gas to the market, a first of its kind.

3. Nina Saxena Excellence in Technology Award, 2011 – hosted by IIT, Kharagpur.

The award is considered prestigious in the wake of the nominations included all areas of technologies.

4. AREAS Foundation Day Awards for excellent performance in R&D on renewable energy - August 2015 (2nd of three recognized Institutions – Award organized by MNRE)