Dr Anand M Shivapuji

Research Scientist

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Education

2016 : PhD from Indian Institute of Science; Bangalore; Karnataka
2003 : M.Tech in Energy Systems Engineering from VTU; Belgaum; Karnataka
1999 : B.Tech in Mechanical Engineering from KUD; Dharwad; Karnataka

Awards and Recognitions

2015 : Best visual presentation award at Shanghai, China
2013 : Young researcher award from Korean Society of Combustion
2004 : University second rank holder in the M.Tech program

Membership and association

1. Life member, Combustion Institute, India chapter
2. National Advisory Board, International conference on recent innovations in civil and mechanical engineering- MNR Group of Institutions; Hyderabad

Publications

Published Journals [05]

1. Shivapuji, Anand M., and S. Dasappa. "Quasi dimensional numerical investigation of syngas fuelled engine operation: MBT operation and parametric sensitivity analysis." Applied Thermal Engineering (2017).
2. Shivapuji, A. M., & Dasappa, S. Analysis of thermodynamic scope engine simulation model empirical coefficients: Suitability assessment and tuning of conventional hydrocarbon fuel coefficients for bio syngas. *Accepted for publication in the International Journal of Hydrogen Energy*.
3. Shivapuji, A. M., & Dasappa, S. (2015). Influence of fuel hydrogen fraction on syngas fueled SI engine: Fuel thermo-physical property analysis and in-cylinder experimental investigations. International Journal of Hydrogen Energy. doi:10.1016/j.ijhydene.2015.06.062
4. Shivapuji, A. M., & Dasappa, S. (2014). Selection and thermodynamic analysis of a turbocharger for a producer gas-fuelled multi-cylinder engine. Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy, 228(3), 340-356.
5. Shivapuji, A. M., & Dasappa, S. (2014). In-cylinder investigations and analysis of a SI gas engine fuelled with H_2 and CO rich syngas fuel: Sensitivity analysis of combustion descriptors for engine diagnostics and control. International Journal of Hydrogen Energy, 39(28), 15786-15802.
6. Shivapuji, A. M., & Dasappa, S. (2013). Experiments and zero D Modeling studies using specific Wiebe coefficients for producer gas as fuel in spark-ignited engines. Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 227(3), 504-519.

Published articles in International / National Conferences proceedings [08]

1. Shivapuji, A. M., & Dasappa, S. (2015). Gas Engine Simulation and Performance Evaluation Tool – A GUI Package, PP 45-47, 21-23 October, Shanghai, China.
2. Shivapuji, A. M., Kumar, A. & Dasappa, S. (2015). Combustion characterization of compressed natural gas and syngas fuelled engine operation under steady and transient conditions, 20 - 22 July 2015, Beijing, China.
3. Shivapuji, A. M., & Dasappa, S. (2011). Experimental studies on multi-cylinder natural gas engine fueled with producer gas. In Proceedings of 19th European biomass conference and exhibition - from research to industry and markets (pp. 974-980).
4. Shivapuji, A. M., & Dasappa, S. (2013). Knock and its prediction in producer gas fuelled SI engines. In Proceedings of ICPS 2013 - International Conference on Polygeneration Strategies, 3 - 5 September 2013 Vienna, Austria
5. Shivapuji, A. M., Kumar, A. Dasappa, S. (2013) Experiments and CFD simulation of producer gas fuelled SI engine: Towards addressing high exhaust enthalpy and cooling loads. In Proceedings of 23rd National Conference on I. C. Engines and Combustion, Surat, Gujrat, India
6. Shivapuji, A. M., & Dasappa, S. (2013). Sensitivity analysis of mixture quality on combustion phasing and its impact on 0D simulation of a producer gas fuelled multi-cylinder engine 19 - 22 May 2013, Gyeongju, South Korea.
7. Shivapuji, A. M., & Dasappa, S. Small capacity producer gas engine adaption from natural gas for decentralized power generation application. The International Bioenergy Conference and Exhibition 2015, Shanghai, China.
8. Shivapuji, A. M., & Dasappa, S. Turbocharger optimization as a power recovery strategy for natural gas engine operation with syngas. Selected for presentation at Emerging Energy Technologies Summit and Exhibition 2016 (EETSE'16) at Melbourne, Australia; December 2016

Employment

August 2015 to present: Research scientist at the Center for Sustainable Technologies, Indian Institute of Science; Bangalore.

The job profile as research scientist at CST primarily includes initiation/partaking of research activities, writing project proposals, specification generation for procurements and teaching assistance. Some of the key participatory aspects are described as below;

Research projects / activities (initiation and/or partaking)

- Syngas fuelled engine governing system characterization: A natural gas engine adopted for producer gas fuelled operation is being characterized for analysis of the governing system classification for both isolated and grid connected power generation system. This is required prior to type approval of the engines.
- Up gradation of manifold upstream supply system for Syngas engines: An up-gradation of the conventional carburetion system has been proposed towards cost reduction and response time improvement. The advanced concept is being tested on a production engine.
- Emission norms evolution and techno-economic impact: The evolution of emission norms in India and the corresponding techno-economic impact is

being assessed. Importance is in respect of the upcoming BS-VI norms which are extremely stringent in terms of permissible tail pipe emissions and also due to the fact that an intermediate step of BS-V has been skipped. Multicomponent optimization on the tailpipe is the key challenge for automotive systems.

- ANSYS-CONVERGE simulation comparative assessment: As a specific objective of a particular project for CUMMINS INC, spark ignited engine simulation performance using ANSYS and CONVERGE commercial tools is being compared. The results have already been reported.
- Numerical investigation of dual fuel engine operation: The dual fuel mode operation of a diesel engine is being investigated towards characterizing the in-cylinder combustion and emissions under peak diesel replacement conditions.
- Numerical investigation of Solid Oxide Fuel Cells: The performance of a Solid Oxide Fuel Cell fuelled with producer gas is being numerically investigated.
- Plasma activation of liquid: Cold plasma activation of regular/treated (demineralized) water is being tested to characterize the activated water for subsequent use as disinfectant, cleaning and growth promoting agent.
- Activated char generation: Chemical activation of biochar using water dissolved KOH supplied into biomass gasification system is being explored.
- Analysis of variation of thermodynamic and transport properties due to composition difference on energy conversion systems like engines and fuel cells.

Participation in project proposal generation and submission to agencies
- Carburetion system development and engine characterization for flexible composition bio-CNG: IMPRINT 2016
- Hydrogen gas engine development: IMPRINT 2016
- Indigenous MW scale producer gas engine development: Indo-UK Collaborative Industrial Research and Development Programme
- Modular extension to commercial/open source CFD software(s) to reduce/eliminate empirical correlations by leveraging parallel computing architecture: DRDO-NSM
- Coal gasification of high ash content Indian coal using cyclone Gasifiers: DST; Coal-2017

Specification generation for procurements
- Single Cylinder Research Engine test bed with adaptable spark/compression ignition engine with endoscopy.
- Commercial grade oxygen supply system with necessary PESO regulations.

Teaching assistance
- Alternative fuels for IC engines
- Renewable energy

August 2008 to July 2015: Took break from employment for pursuing Doctoral Research program at Indian Institute of Science, Bangalore.

June 2004 to July 2008: Faculty in the position of Lecturer and Sr Lecturer at B.V.Bhoomaraddi college of Engineering and Technology

In the position of Lecturer and Sr Lecturer, handled thermal stream subjects like Basic and Applied thermodynamics, Fluid mechanics and dynamics, Combustion engineering, Computational fluid dynamics as a part of academic teaching program for bachelors and masters program students. Was member of institute Central Data Processing Cell tasked with collation and automation of institute data. Was also associated with VIKAS, the human resource development program tasked with training students for corporate interview process. Under my mentorship, students have won four national level project competitions.

June 2002 to May 2004: Took break from employment for pursuing Masters Program at B.V.B College of Engineering and Technology, Hubli.

August 2000 to May 2002: Technical lead, Netmategroup, New Jersey

Primary responsibility involved development of static and dynamic group company websites. Key contribution has been the development of a cross platform compatible web based chat application and wireless application protocol based push messaging platform.

October 1999 to July 2000: Graduate apprentice trainee MID, AITG, ISRO Satellite Center, Bangalore.

Worked on design and development of satellite transportation system to incorporate shock and vibration isolation

Invited lectures/training programs

1. Delivered two lectures on engine adaptations for non-regular fuelled operation and Bharat VI emission norms at 2 day workshop on Advances on IC Engines at PES Institute of Technology and Management at Shivamogga, Karnataka, April 2017
2. Delivered a lecture on Biomass based Energy at the one day training for Deputy Conservator forests/Assistant Conservator of forests on "Renewable Energy, Energy Conservator and Rain Water Harvesting" at Mahatma Gandhi Institute of Rural Energy & Development, Bangaluru, December 2016
3. Delivered a lecture on Biomass based Energy at the one-week compulsory refresher course for IFS officers on "Energy Conservation- Alternate Technology" at Mahatma Gandhi Institute of Rural Energy & Development, Bangaluru, September 2016
4. Conducted a three day training program on CHEMKIN at Central Salt and Marine Chemicals Research Institute, Bhavnagar; May 2016
5. Delivered a lecture on Biomass Gasification and Producer Gas a fuel for IC Engines at PDA Gulbarga, at the one week Faculty Development Program on Renewable and Alternative Energy Sources; August 2012
6. Delivered a lecture on Biomass Gasification - Towards a sustainable future at the department of studies and research in social work, Davangere, at the national symposium on Renewable Energy and Sustainable Development; March 2012

Computational skills

Programming languages

3. Advance level proficiency in C;C++;Fortran;Python;Matlab
4. Advance level proficiency in HTML;Javascript;StyleSheets;
5. Intermediate level proficiency in MPI/OpenMP/OpenCL concepts

Simulation tools

1. CHEMKIN: Advance level proficiency in equilibrium, flame speed, ignition delay time, reaction path way analysis and HCCI engine simulations. Intermediate level proficiency in catalytic process analysis and beginner level proficiency in vapour deposition and plasma analysis.
2. ANSYS/CONVERGE/OpenFOAM: Advance level proficiency in multi-dimensional simulation of internal combustion engines.
3. MATLAB/PYTHON using SyPy: Advance level proficiency in using solver modules for numerical programming.

Doctoral thesis research details

The research work basically involved performance characterization and non-intrusive engine optimization on fuelling a multi-cylinder conventional fuel (natural gas) engine with non-regular gaseous alternative fuel (producer gas). A six cylinder turbocharged natural gas engine derived from diesel frame is fuelled with producer gas a low calorific value bio-derived alternative with composition of 19 ± 1% CO and H2, 2 ± 0.5 % CH4, 12 ± 1% CO2 and 46 ± 1% N2 and performance is optimized adopting experimental and numerical approach..

Turbocharged operation of the engine with producer gas indicates a 50% de-rating over thermodynamic peak load estimates. Peak load of 72.8 kWe (BMEP 9.47) is realized at maximum brake torque ignition angles of 22 deg before TDC and compressor pressure ratio of 2.25 following turbocharger matching and optimization. Engine energy distribution analysis indicates skewed energy balance with higher cooling load (in excess of 30%) as compared to fossil fuel operation; attributed to the presence of nearly 20% H2 in the fuel which enhances the convective cooling through higher thermal conductivity. Process level comparison indicates significant deviations in the heat release profile compared to fossil fuels.

Analyzing the implications through numerical investigation, the influence of the altered thermo-kinematic response for producer gas fuelled operation impacts 0D simulations requiring fuel specific coefficients. The analysis is extended to quasi-dimensional analysis through the eddy entrainment and laminar burn-up model. In-cylinder engine simulation results covering parametric variation of load, ignition angle and mixture quality, for engine natural gas fuelled naturally aspirated operation and producer gas fuelled naturally aspirated and turbocharged after-cooled are compared with experimental results. The quasi dimensional analysis is extended to simulate end gas auto-ignition and is validated by using experimental manifold conditions for turbocharged operation for which knock has been observed. Extending the model to a Waukesha cooperative fuels research engine, motor methane number of 110 is reported for standard composition producer gas. The use of quasi-dimensional models with end gas reaction kinetics enabled for knock rating of fuels represents first of its kind initiative.

Personal details

Date of birth	02 July 1978
Place of birth	Hubli; Karnataka; India
Languages known	Kannada; English; Hindi

Thanking you

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