# P. SESHU

**Professor of Mechanical Engg, IIT Bombay (since 1989)** 

Founder Director, IIT Dharwad (2017-2022)

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### **RESEARCH FIELDS**

- Computational Mechanics (Finite elements, stress & vibration analysis)
- Smart Structures
- $\succ$  Robotics
- Vehicle Dynamics
- Dynamics and Simulation of High Speed Mechanisms

### **SPONSORED PROJECTS**

Associated (PI, Co-PI, Head of the Institution) with several projects to the tune of about INR 150cr.

### **INDUSTRIAL INTERACTION**

- Retainer Consultant (CAE), Mahindra and Mahindra Ltd., 1997-'99
- Several projects/courses (along with colleagues) for many industries such as Apollo Tyres, Applied Materials, Bajaj Auto, BHEL, CEAT, Crompton Greaves, General Motors, Larsen & Toubro, Mahindra and Mahindra, Nuclear Power Corporation, Reliance Industries, etc.

# **RECOGNITION / AWARDS / HONORS**

- Chairman, Apex Committee, DRDO Asymmetric Technologies Lab, Hyderabad (2019 onwards)
- Member, Board of Governors, Indian Institute of Information Technology Dharwad (IIIT Dharwad, 2021-'22).

- Member, Board of Governors, Indian Institute of Science Education and Research, Thiruvananthapuram (2021-'22).
- Member, Technical Evaluation Committee for EVM for State Election Commissions (2019-'22)
- Member, Academic Council, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru (2021 onwards)
- Member, Research Council, CSIR CMERI, Durgapur (2017-'20)
- Member, Advisory Committee, CSIR 4PI, Bengaluru (2018-'20)
- Member, National Expert Committee for Design Review, Arjun Battle Tank Repair and Recovery Vehicle, DRDO, 2015.
- Distinguished Alumnus Award, NIT Warangal, 2019 (Golden Jubilee Year)
- Best paper award (3rd position) in International Conference on Robotics and Smart Manufacturing, IIITDM Kancheepuram, India, 2018
- Prof. A. Jaganmohan Award for Professional Development, 2016
- > DP Joshi Award for Professional Development, 2016
- Member, International Scientific Advisory Committee, Fifth International Congress on Computational Mechanics and Simulation (ICCMS 2014), Chennai, Dec. 2014.
- Member of national delegation to Germany for specialist workshop on big data applications in engineering, March 13-15, 2013.
- Member of national delegation to UK for EPSRC/DST Scoping Meeting in Applied Mathematics from 11th – 13th July, 2012.
- Invitations for reviewing manuscripts from several journals such as ASME Transactions, ASCE Transactions, Applied Acoustics, Smart Materials and Structures, International Journal of Materials and Product Technology, Robotica, etc.
- > Reviewer of project proposals for DST, Govt. of India
- > Invited/Keynote speaker at National/International Conferences
- > Prof. A. Jaganmohan award for Professional Development, 2009
- ► Excellence in Teaching Award, IIT Bombay (2008)
- ► Excellence in Teaching Award, IIT Bombay (2004)
- > Teacher of the Year, Mechanical Engg Dept, IIT Bombay (2002)
- Mentor of the Year, Mechanical Engg Dept, IIT Bombay (2001)
- Royal Society Indian National Science Academy Fellowship (1999)
- Ranked First in M. Tech. (Design Stream), IIT Madras (1986)
- ▶ Ranked First in the University in B.Tech. (1984)
- > Ranked First in the State of Andhra Pradesh, India in XII Standard (1980)

# Ph.D. THESES GUIDED

- Multi-objective Design of Heavy Goods Vehicle Suspension System using Geometry-Inspired Genetic Algorithm, Vikas Prasad, Prof. DN Pawaskar (Guide) and Prof. Seshu (Co-Guide), 2021
- 2) Biodynamic Response of a Human Body Model Integrated with Vehicle Model, Raj Desai, Prof. A. Guha (Guide) and Prof. Seshu (Co-Guide), 2021
- 3) Form Finding and Stability Analysis of Tensegrity Structures, Pramod Kumar Malik, Prof. Seshu (Guide) and Prof. A. Guha (Co-guide), 2021
- Thermo-mechanical Analysis of Coolant Channels for Heavy Water Reactors under Accident Conditions, AK Dureja, 2013 (Jointly supervised with Prof. DN Pawaskar, Mechanical Engg Dept and Dr. RK Sinha, BARC)
- 5) Optimization of Passive Suspension Systems, MJ Pable, 2011
- 6) Optimal Sizing and Placement of Piezoelectric Sensors/Actuators for Active Vibration Control of Flexible Structures, KD Dhuri, 2008
- 7) Numerical Modelling of Near-Infrared Light Propagation for Diffuse Optical Tomography, Mita Bhowmick, 2008 (Jointly supervised with Prof UB Desai, Electrical Engg Dept)
- 8) Studies on Piezoelectric Actuated Shell with Application to Optimal Steering of Antenna, VK Gupta, 2003 (Jointly supervised with Prof. K. Kurien Issac, Mechanical Engg Dept)
- 9) Dynamics and Stabilization of Under-actuated Monopedal Hopping, PV Shanmuganathan, 2002 (Jointly supervised with Prof. B. Seth, Mechanical Engg Dept)

### MASTERS THESES GUIDED

More than 50

# **LEADERSHIP ROLES AT THE NATIONAL LEVEL**

a) Founder Director IIT Dharwad 2017-'22

Academic Innovations in line with NEP 2020:

- Initiated Interdisciplinary & Multidisciplinary Programs (IMPs), 2 or more depts jointly offering degree programs, the mantra of IITDh. 5 new IMPs are on offer (2 BTech, 2 MTech and BS-MS).
- > Launched Minor programs in Energy & Environment, Data Science and AI etc.
- Started Co-op program for Industry-readiness 40% pre-final year students placed.
- Conceptualised Holistic Personality Development of student through unique courses Intro to Fine Arts (leveraging the rich cultural heritage of this region); Design Thinking and Creativity etc.

### **R&D Projects of National Relevance and Industry Collaborations:**

- > 11cr sponsored R&D and 1.5 Cr industrial consultancy projects by IITDh Faculty ongoing.
- > 1.5 Cr Space Data Science Lab sponsored by Antrix Ltd.
- > 25 Cr CoE on Affordable and Clean Energy (with SELCO & Honeywell) (await final clearance).
- Thrust areas Renewable Energy, Precision Agriculture (IITDh + Univ. of Agri. Sci. Dharwad, and Deshpande Foundation Hubli), Indian Knowledge Systems, and Sustainable and Smart Mobility.
- > Nearly **200 publications** by faculty with IITDh affiliation in 4 years.

#### Infrastructure Development of Permanent Campus (INR 1,062 Cr):

- > Indian Concrete Institute (ICI) Ultratech Award 2023 for Outstanding Project
- > 5 Star GRIHA LD Master Plan Rating by GRIHA
- > 100% Rainwater harvesting; 100% STP treated water reuse; 75% solar; SCADA remote monitoring

#### Institute Outreach, Social Responsibility & Visibility:

- Conceptualised and launched DIAL days (Development of Industry Academia Linkage).
- Collaborated and signed MoUs with several organisations such as JCB, McAfee, Altair, Zeus Numerix, CSIR Labs, and International Universities in Canada, Germany, Taiwan, Finland etc.
- COVID work- Mobilised IITDh to manufacture and distribute 20,000+ face shields, several intubation boxes, develop self-operated kiosks for vaccination queue management in KIMS Hospital.

### b) Head, CSIR CMMACS, Bangalore from 11/10/2010 – 31/1/2014;

- Instrumental in the transformation of the Center (CMMACS) to a multi-location national Institute (CSIR Fourth Paradigm Institute) dedicated to high end computational and data intensive science with nearly SEVEN FOLD increase in sanctioned strength
- Secured grants to the tune of Rs. 100 Crores for the new projects in HPC and advanced research in earth & engineering sciences
- Successfully established then India's largest CPU based High Performance Computing cluster (360 TeraFlop) in CMMACS – popularized its usage across the CSIR Labs which led to peak utilization crossing 90% on several occasions.
- > Led CSIR efforts for petascale High Performance Computing
- Steered formulation of the doctoral program of CMMACS under the aegis of the Academy of CSIR (AcSIR)
- Initiated online rendering of courses across multiple CSIR Labs using open source software.
- Launched SPARK program in CMMACS which has attracted bright students from premier institutions in more than 20 states of India.

# c) Cluster Director, CSIR Information Sciences Cluster 11/6/2011 – 31/1/2014;

Responsible (jointly with co-cluster director Dr. P. Banerjee) for looking after the four CSIR laboratories/units under this cluster – namely, CMMACS (Bangalore); NISCAIR (Delhi); NISTADS (Delhi); URDIP (Pune) for the preparation of 12th Five Year plan projects

# d) Dean, Mathematical and Information Sciences, AcSIR (Academy of CSIR) 27/8/2012 – 31/1/2014

- Responsible (jointly with Assoc. Dean Dr. Mathur) for looking after the academic programs of four CSIR laboratories/units under this cluster – namely, CMMACS (Bangalore); NISCAIR (Delhi); NISTADS (Delhi); URDIP (Pune)
- Responsible (jointly with Assoc. Dean Dr. Mathur) for looking after any academic issues of AcSIR

### e) Member - Core Group for the 12 Five Year Plan document of CSIR

Contributed to the preparation of the 12th Five Year Plan (2012-17) document of CSIR

### f) Convener, DST KVPY (Engg) from 2007-'10;

Steered the DST national level flagship program Kishore Vaigyanik Protsahan Yojana (KVPY) for Engineering students all over India

### **Positions held within IIT Bombay**

- Inaugural Convener of IIT Bombay Research Fellowship scheme in which nearly 70 colleagues from various Depts. in IIT participated.
- Convener-Growth Plan Committee of Mech Engg Dept
- ➢ Vice-Chairman, GATE
- ≻ Group Leader, Design Engg Group, Mech. Engg Dept., IIT Bombay
- Discipline Coordinator, NPTEL Video and Web Modules Development

### **PUBLICATIONS**

### BOOKS

- P. Seshu, "Text Book of Finite Element Analysis", Prentice Hall of India Ltd.
  - 1<sup>st</sup> Edition printed in 2003
  - Reprinted every year since then 12<sup>th</sup> reprint 2014
  - More than 30000 copies sold;
  - Prescribed book by many Universities and AICTE Model Curriculum 2018.
  - ISBN-978-81-203-2315-5

### **RESEARCH PAPERS (past 20 years)**

### **International Journals**

- 1) Topology Identification for Super-stable Tensegrity Structure from a Set of Given Number of Nodes in a Two-dimensional Space, Pramod Kumar Malik, Anirban Guha and P. Seshu, Mechanics Research Communications, Elsevier, v119, 2022, 103810.
- 2) An appropriate biomechanical model of seated human subjects exposed to whole-body vibration, Raj Desai, Anirban Guha, P Seshu, Proceedings of the Institution of Mechanical Engineers, Part K: Journal of Multi-body Dynamics, 2021, 235(4):586-601.
- A comparison of different models of passive seat suspensions, Raj Desai, Anirban Guha, P Seshu, Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile engineering, 235 (9), 2021, pp. 2585-2604.
- 4) Modelling and simulation of active and passive seat suspensions for vibration attenuation of vehicle occupants, Raj Desai, Anirban Guha, P Seshu, International Journal of Dynamics and Control, 2021, v9, pp. 1423-1443.
- 5) Controller design and multi-objective optimization of heavy goods vehicle suspension system by geometry-inspired GA, Vikas Prasad, Dnyanesh N Pawaskar, Pasumarthy Seshu, Structural and Multidisciplinary Optimization, 2021, v9, 983-1001.
- 6) A comparison of quarter, half and full car models for predicting vibration attenuation of an occupant in a vehicle, Raj Desai, Anirban Guha, P Seshu, Journal of Vibration Engineering & Technologies, 2021, pp. 1-19.
- Modelling and simulation of an integrated human-vehicle system with non-linear cushion contact force, Raj Desai, Anirban Guha, P Seshu, Simulation Modelling Practice and Theory: Elsevier, 106 (2021), 102206.
- Multibody Modelling of the Human Body for Vibration Induced Direct and Cross-axis Seat to Head Transmissibility, Raj Desai, Anirban Guha and P. Seshu, Proc. of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 2021, 235(17):3146-3161.
- Multibody Biomechanical Modelling of Human Body Response to Direct and Cross Axis Vibration, Raj Desai, Anirban Guha and P. Seshu, Procedia Computer Science, 2018, 133, pp. 494-501.

- 10) Thermomechanical Behavior of Coolant Channel Assembly in Heavy Water Reactor Under Severe Plant Condition, Dureja, A.K., Seshu, P., Pawaskar, D.N., Sinha, R.K., ASME Journal of Nuclear Engineering and Radiation Science, April 2017.
- Experimental determination of thermal contact conductance between pressure and calandria tubes of Indian pressurised heavy water reactors, Dureja, A.K., Pawaskar, D.N., Seshu, P., Sinha, S.K., Sinha, R.K., Nuclear Engineering and Design, 284 (2015), 60–66.
- 12) Modelling flow and work hardening behaviour of cold worked Zr–2.5Nb pressure tube material in the temperature range of 30–600°C, A.K. Dureja, S.K. Sinha, D.N. Pawaskar, P. Seshu, J.K. Chakravartty and R.K. Sinha, Nuclear Engineering and Design, 269 (2014), 52–56.
- 13) Design of 'Road Friendly' Suspensions for Quarter and Half Heavy Goods Vehicle Models by using Genetic Algorithm and Multi-Objective Performance Index, M. J. Pable and P. Seshu, International Journal of Vehicle Systems Modelling and Testing, 2012, volume 7 (1), pp. 26-53.
- 14) Flow behaviour of autoclaved, 20% cold worked, Zr2.5Nb alloy pressure tube material in the temperature range of room temperature to 800°C, A. K. Dureja, S. K. Sinha, Ankit Srivastava, R. K. Sinha, J. K. Chakravartty, P. Seshu and D. N. Pawaskar, Journal of Nuclear Materials, 2011, vol. 412, pp. 22-29.
- 15) Optimization of Passive Suspensions to Mimic Active Suspensions, MJ Pable and P Seshu, International Journal on Advances in Vibration Engineering, v9, n2, 2010, pp. 131-144.
- 16) Analytical solution in 2D domain for nonlinear response of piezoelectric slabs under weak electric fields, M. K. Samal and P. Seshu, Communications in Nonlinear Science and Numerical Simulation 01/2009; 14(6):2817-2826.
- 17) Multi-objective optimization of piezo actuator placement and sizing using genetic algorithm K.D. Dhuri and P.Seshu, Journal of Sound and Vibration, 323 (2009), 495–514.
- 18) On the non-linear response of piezoelectric slabs under weak electric fields: experimental and analytical modelling, MK Samal and P Seshu, Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 2009, 223:1493-1506.
- 19) A mathematical model in three-dimensional piezoelectric continuum to predict non-linear responses of piezoceramic materials, MK Samal, P Seshu, U vonWagner, P Hagedorn, B K Dutta and H S Kushwaha, Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 2008, 222: 2251-2268.
- 20) An analytical formulation in 3D domain for the nonlinear response of piezoelectric slabs under weak electric fields, M.K. Samal, P. Seshu and B.K. Dutta, International Journal of Solids and Structures, 44 (2007), 4656–4672.
- 21) Modeling and application of piezoelectric materials in smart structures, M.K. Samal, P. Seshu, and B. K. Dutta, International Journal of Condition Monitoring and Diagnostic Engineering Management (COMADEM), 2007, v10, n2, pp. 30-42.
- 22) Optimal steering of a paraboloid antenna using piezoelectric actuators, V K Gupta, P Seshu, K Kurien Issac and R K Shevgaonkar, Smart Materials and Structures, 16 (2007), 67–75.
- 23) Corrected Formulas for Natural Frequencies of Cantilever Beams Under Uniform Axial Tension, P. Seshu and K. D. Dhuri, AIAA Journal, Vol. 45, No. 6, June 2007, 1435-1438.

- 24) Favorable locations for piezo actuators in plates with good control effectiveness and minimal change in system dynamics, K D Dhuri and P Seshu, Smart Materials and Structures, 16 (2007), 2526–2542.
- 25) Single-legged hopping robotics research A review, Ajij Sayyad, B. Seth and P. Seshu, Robotica 01/2007; 25:587-613.
- 26) Search for Initial Conditions for Sustained Hopping of Passive Springy-Leg Offset-Mass Hopping Robot, B. Seth, P. Seshu, P. V. Shanmuganathan, V. V. Vichare and P. Raj, Journal of Dynamic Systems Measurement and Control -Transactions of The ASME, 2007, 129(4), pp. 522-526. (6th most downloaded paper in this journal during July 2007)
- 27) Piezo Actuator Placement and Sizing for Good Control Effectiveness and Minimal Change in Original System Dynamics, K. D. Dhuri and P. Seshu, Smart Materials and Structures, 2006, vol. 15, no. 6, 1661-1672.
- 28) Nonlinear Behaviour of Piezoceramics under Weak Electric Fields, Part-I: Finite Element Formulation, M. K. Samal, P. Seshu, S. Parasar, U. von Wagner, P. Hagedorn, B. K. Dutta, H. S. Kushwaha, International Journal of Solids and Structures, 2006, 43 (6), pp. 1422-1436.
- 29) Nonlinear Behaviour of Piezoceramics under Weak Electric Fields, Part-II: Numerical Results and Validation with Experiment, M. K. Samal, P. Seshu, S. Parasar, U. von Wagner, P. Hagedorn, B. K. Dutta, H. S. Kushwaha, International Journal of Solids and Structures, 2006, 43 (6), pp. 1437-1458.
- 30) Experimental Studies on Active Vibration Control of a Beam using Hybrid Active/passive Constrained Layer Damping Treatments, Pankaj Langote and P. Seshu, ASME J. of Vibration and Acoustics, v127, n5, 2005, pp. 515-518.
- 31) Beam Steering and Shaping of Smart Cylindrical Antenna, V.K. Gupta, P. Seshu, K. Kurien Issac, R.K. Shevgaonkar, AIAA Journal, 2005, v43, n1, pp. 165-173.
- 32) A finite element model for nonlinear behaviour of piezoceramics under weak electric fields, M.K. Samal, P. Seshu, S. Parashar, U. vonWagner, P. Hagedorn, B.K. Dutta, H.S. Kushwaha, Finite Elements in Analysis and Design, v41 (2005), pp. 1464–1480. (ranked within top 25 articles in this journal during Oct Dec 2005)
- 33) Finite Element and Experimental Investigation of Piezoelectric Actuated Smart Shells, V.K. Gupta, P. Seshu, K. Kurien Issac, AIAA Journal, v42, n10, 2004, page 2112-2123.

### **National Journals**

- Development of a Hexaped Walking Robot Mechanical Design, C. Amarnath, K. Kurien Issac, B. Seth, P. Seshu, A. Kharade, S. K. Pathak, V. Deshmukh and P. Deshmukh, Inst. of Engineers India Journal, March 2007, v87, pp. 20-24.
- 2) Passive Dynamics of Kangaroo-like Hopping Robot, P. Seshu, B. Seth and V. Shanmuganathan, Inst. of Engineers India Journal, Sept. 2006, v87, pp. 39-45.
- Characterization of the Role of Adhesive Bonding on Piezoelectric Actuation of Beams, S. D. Dhage, V. K. Gupta, P. Seshu, P. M. Mujumdar and B. Seth, Journal of Aerospace Sciences and Technologies, India, 2006, v58, n3, pp. 225-233.
- Finite Element Analysis of a Beam with Active Constrained Layer Damping (ACLD) Treatment, Pankaj K. Langote and P. Seshu, Journal of Aerospace Sciences and Technologies, 2004, v56, n4, pp. 240 – 253.

### **International Conferences**

- Thermo-mechanical Contact Behaviour of Pressure and Calandria Tubes in a Nuclear Reactor Postulated Accident Scenario, P. Seshu, A. K. Dureja, R. K. Sinha and D.N. Pawaskar, International Congress on Computational Mechanics and Simulation (ICCMS), IIT Hyderabad, 10-12 December, 2012.
- Optimization of passive suspensions for Tractor Semi-Trailer model by mimicking active suspensions, M. J. Pable and P. Seshu, Keynote address, Proceedings of the 6th International Conference on Vibration Engineering and Technology of Machinery (VETOMAC-VI), Indian Institute of Technology, Delhi, Dec. 2010, pp. 607-624.
- 3) Computational Analysis of Thermo-Mechanical Contact Behaviour of Two Co-axial Tubes, A.K. Dureja, P. Seshu, D. N. Pawaskar and R. K. Sinha, 3rd International Congress on Computational Mechanics and Simulation, Mumbai, Dec. 2009, pp. 223-224
- 4) FEM based Computational Model for Image Reconstruction in Diffuse Optical Tomography, Mita Bhowmick, P. Seshu, U.B. Desai, M.P. Thaddeus, International Conference on Multi-scale Modeling and Simulation, 2-4 Jan. 2008, IISc., Bangalore.
- 5) Design of Passive Suspensions to Reduce Actuator Control Effort, Machhindra Pable, P Seshu, Proceedings of the IFToMM World Congress on Mechanisms and Machine Science, France, 17-21, June, 2007.
- 6) Position control of flexible parallelogram five-bar manipulator using piezoelectric sensors and actuators, K. D. Dhuri and P. Seshu, Proceedings of the IFToMM World Congress on Mechanisms and Machine Science, France, 17-21, June, 2007.
- Prediction of hysteresis behaviour of piezoelectric materials under varying electric fields, M.K. Samal, P. Seshu, B.K. Dutta, Proceedings of the 8th International Conference on Vibration Problems (ICOVP-2007), Bengal Engineering and Science University, Shibpur, India, 30th January-3rd February 2007.
- 8) Active vibration control of flexible-link manipulators using piezoelectric sensors and actuators, Dhuri, K.D. and Seshu, P., Proc. of 3rd Int. Conf. on Autonomous Robots and Agents 2006, December 12-14, 2006, Palmerston North, New Zealand, pp.93-98.
- 9) A Two Dimensional Analytical Solution Technique for Modeling Nonlinear Response of Piezoceramic Structures, M. K. Samal, P. Seshu, B. K. Dutta, H. S. Kushwaha, Proc. of the ISSS International Conf. on Smart Materials, Structures and Systems, IISc, Bangalore, July 2005, Paper No. ISSS-2005/SB-28.
- Development of Servo Driven Four Bar Mechanism For Constant Speed Application, Vivek Jain, KD. Dhuri, P. Seshu and B. Seth, Proc. of the 9<sup>th</sup> IFToMM International Symposium on Theory of Machines and Mechanisms, Bucharest, Romania, Sept. 1-4, 2005, vol. 1, pp. 53-58.
- Use of Piezoelectric Materials for Smart Structure Applications, P. Seshu and M.K. Samal, 3<sup>rd</sup> Indo-German Theme Meeting on Structural Integrity and Safety, BARC., Mumbai, India, 2005, pp. DM04.01-24.

12) Piezoelectric Actuated Antenna Shells, V. K. Gupta, P. Seshu, K. Kurien Issac, and R. K. Shevgaonkar, Proceedings of the 11<sup>th</sup> IFToMM World Congress in Mechanism and Machine Science, vol. 3, pp. 1336-1340, April 1-4, 2004, Tianjin, China.

### **National Conferences**

- A Review of 'Road-Friendly' Suspensions, M. J. Pable, M. M. Gawture, P. Seshu, 13<sup>th</sup> National Conference on Mechanisms and Machines (NaCoMM07), IISc, Bangalore, India, December 12-13, 2007
- Formulation of a Multi-objective Optimal Control Problem for Active Suspension Performance Improvement, P. Seshu, A. Ambekar, H. Nema and M. J. Pable, Proc. Of National Conference on Industrial Problems in Machines and Mechanisms, I.I.T., Kharagpur, Feb. '05, pp. 279-286.
- 3) Finite Element Analysis of High Aspect Ratio Fan Blades, Sandeep Dhar, P. Seshu and B. Roy, Proc. of the 7<sup>th</sup> National Conference on Air Breathing Engines and Aerospace Propulsion, Nov. 5-7, 2004, I.I.T., Kanpur, pp. 637-648.