

Santhakumar Mohan, Ph. D. (IIT Madras)

Associate Professor, Mechanical Engineering

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Research Interests

Broadly, I work in the field of Robotics and Control. Specifically, I have research interests as follows:

- Field Robotics, Mobile Manipulators and Underwater Robotic Systems (Dynamics and Control)
- Assistive and Rehabilitation Robots (Lower Limb Rehabilitation Robots)
- Parallel Robotic Platforms (Mechanical Design, Dynamics and Control)

Academic Preparation

Ph. D. in Engineering Design (Specialisation in Robotics and Control)

Indian Institute of Technology Madras, Chennai, India 2007-2010 Advisor: Prof. T. Asokan

Dissertation: Investigations on trajectory tracking and dynamic station keeping control of an underactuated flatfish type autonomous underwater robotic vehicle.

M. E. in Mechanical Engineering (Specialisation in Manufacturing Engineering)

Government College of Technology, Coimbatore, India 2003-2005 Advisor: Prof. P.K. Jayadev

Thesis: Kinematic calibration and optimum path planning of a SCORA ER 14 (SCARA) robotic manipulator using a vision system.

B. E. in Mechanical Engineering

Government of College of Engineering, Salem, India 1999-2003 Advisor: Prof. R. Marappan

Project: Design and development of a vehicle manipulator system and implementation of an ultrasonic sensor for an exploration.

Professional Experience

Regular positions

Associate Professor, Indian Institute of Technology Palakkad, INDIA Dec. 2018 – present

Associate Professor, Indian Institute of Technology Indore, INDIA May 2017 – Dec. 2018

Alexander von Humboldt Research Fellowship, RWTH Aachen, GERMANY May 2016 – May 2017

Assistant Professor, Indian Institute of Technology Indore, INDIA Mar. 2012 - May 2017

Postdoctoral Research Fellow, KAIST, Daejeon, ROK Mar. 2011 - Mar. 2012

Assistant Professor, National Institute of Technology Calicut, INDIA Jul. 2010 - Mar. 2011

Teaching Assistant, Indian Institute of Technology Madras, INDIA Jan. 2007 - Jul. 2010

Lecturer, Bannari Amman Institute of Technology, Sathy, INDIA Jul. 2005 - Dec. 2006

Research Assistant, Government College of Tech. Coimbatore, INDIA Aug. 2003 - Jun. 2005

Visiting positions

Visiting Professor, Belgorod State Technological University, Belgorod, Russia 2019-2022

Visiting Professor, Ecole Centrale de Nantes, FRANCE April 2017 and May 2019

Visiting Faculty, ME, Indian Institute of Science, Bangalore, INDIA May - Jun. 2015

Visiting Assistant Professor, C-FRIEND, KAIST, Daejeon, ROK Dec., 2014, July - Aug. 2015

Visiting Assistant Professor, ORIN, OSE, KAIST, Daejeon, ROK May - Jun. 2013

Visiting Professor, PSG College of Technology, Coimbatore, INDIA Dec. 2013 – Dec. 2020

Honours and Awards

- Received the Alexander von Humboldt research fellowship from Alexander von Humboldt Foundation, GERMANY 2016-2017
- Received the European Master on Advanced Robotics Plus (EMARO+) fellowship from Erasmus Mundus, FRANCE 2018-19
- Satellite Across Virtual Institute (SAVI) research fellowship from National Research Foundation, ROK 2013-2015
- Outstanding Young Scientist Award from Korea Robotics Society (KROS), ROK 2014
- Best Teacher (Academic Excellence) Award from IIT Indore, India 2013
- Received the World Class University (WCU) and the Brain Korea (BK21) fellowships to conduct research at KAIST, Daejeon, ROK 2011-2012
- Awarded National Doctoral Fellowship (NDF) from AICTE, New Delhi, 2007
- Gold Medal (Memorial Award) from Government of College of Engineering, Salem, India 2003

Sponsored Research Projects

Project Title	Agency	Status and Budget	Outcomes
High-performance methods of digital design, optimization, and control of robotic systems for logistics and transport-technological work in the agro-industrial complex	Russian Science Foundation (RSF), Russia	Ongoing (2022-2024) Rs. 190 Lakhs	1 PhD pursuing
Robust operational space motion control of a waist assistive powered exoskeleton	Centre for Artificial Intelligence & Robotics (CAIR), India	Ongoing (2021-2022) Rs. 31.76 Lakhs	1 Master pursuing
Design, Development and Control of a Multi-purpose Mobile Manipulator for Intelligent and Collaborative Manipulation Tasks	IIT Palakkad Technology IHub Foundation (IPTIF), India	Ongoing (2021-2025) Rs. 79 Lakhs	1 PhD pursuing
Design and Development of an Intervention-class Underwater Robotic Vehicle with Tilting Thrusters for Marine Applications	IIT Palakkad Technology IHub Foundation (IPTIF), India	Ongoing (2021-2025) Rs. 78 Lakhs	1 PhD pursuing
Robotics and Automation in Agriculture	Ministry of Electronics and Information Technology (MeitY), India	Ongoing (2020-2023) Rs. 51.84 Lakhs	1 PhD pursuing 1 SCI paper
Design and Development of an intelligent Underwater Vehicle with a Manipulator for offshore oil/gas and other marine applications	Naval Research Board (NRB), India	Ongoing (2020-2023) Rs. 45.25 Lakhs	1 PhD pursuing 1 SCI paper
Design and Development of a new sitting-type lower limb rehabilitation robot	Council of Scientific and Industrial Research (CSIR), India	Ongoing (2020-2023) Rs. 23.21 Lakhs	1 MS 1 SCI Paper
Development of a hybrid robotic system based on a passive orthosis and an active parallel manipulator for the lower limb rehabilitation	Russian Science Foundation (RSF), Russia	Ongoing (2019-2022) Rs. 190 Lakhs	1 PhD pursuing 1 SCI Paper

Bio-inspired Hybrid Underwater Vehicle for Ocean Observations	Science and Engineering Research Board (SERB), India	Ongoing (2019-2022) Rs. 28.85 Lakhs	1 PhD 1 SCI Paper 1 Patent
Robust motion control design for an underwater robot with tilting thrusters	Department of Science and Technology, India	Completed (2018-2021) Rs. 25.14 Lakhs	2 PhD 4 SCI papers
Teaching Learning Centre on "Internet of Things"	Department of Higher Education, India	Completed (2016-2020) Rs. 143 Lakhs	1 PhD 4 SCI papers
Design and development of an economical, lightweight and multi-purpose four degrees of freedom hybrid robotic motion platform	Council of Scientific and Industrial Research (CSIR), India	Completed (2016-2019) Rs. 18.96 Lakhs	1 PhD 2 SCI papers
Design, development and control of a new three degrees of freedom (3-dof) parallel robot for x-y theta (xyθz) motion(approx. Rs. 13.32 Lacs) (2013-2016)	Department of Science and Technology (DST), India	Completed (2013-2016) Rs. 13.32 Lakhs	1 PhD 4 SCI Papers 1 Patent
Development of an underwater robotic research platform for the autonomous control and manipulation tasks	National Research Foundation (NRF) of Korea, Republic of Korea	Completed (2013-2015) Rs. 16 Lakhs	1 MS 3 SCI Papers
Design of a popup antenna system for intermittent communication of an observed underwater noise and which remains submerged otherwise	Naval Research Board (NRB), India	Completed (2014-2016) Rs.14.86 Lakhs	1 PhD 2 SCI Papers
Development and Control of a Kinematically Redundant Teleoperated Mobile Manipulator for Mining / Rescue Operations	Department of Science and Technology (DST), India,	Approved in 2015 Rs. 165 Lakhs	Withdrawn due to AvH visit

Administrative Services

Dean, Industry Collaboration and Sponsored Research, October 2020-present

Faculty in-charge (equivalent to Dean), International Relations, July 2019 - December 2020

Associate Dean, Academic Affairs, October 2017 – November 2018

Founding Director, IIT Palakkad Technology Ihub Foundation, December 2020-present

Founding Director, Technology Innovation Foundation of IIT Palakkad, December 2020-present

Summary of Publications

1. Journal Papers/articles: 58 (Published)
2. Patents: 4 (Indian Patents, Published)
3. Book Chapters: 20
4. International Conferences: 67

Patents

1. **Santhakumar Mohan** and Yogesh Singh, A MECHANISM OF 2PRP-PRR PLANAR PARALLEL MANIPULATOR AND A METHOD THEREOF, India, 4678/MUM/2015, 2015 (Published, The Patent Office Journal No. 24/2017 Dated 16/06/2017 page 20581)
2. **Santhakumar Mohan** and Jayant Kumar Mohanta, A REHABILITATION ROBOT FOR LOWER LIMB GAIT THERAPY, India, 4757/MUM/2015, 2015 (Published, The Patent Office Journal No. 25/2017 Dated 23/06/2017 page 21372)
3. **Santhakumar Mohan** and Jayant Kumar Mohanta, SIX DEGREE OF FREEDOM PARALLEL MANIPULATOR IN RPRS CONFIGURATION, India, 201621019170, 2016 (Published, The Patent Office Journal No. 49/2017 Dated 08/12/2017 page 47906)
4. Jagadeesh Kadiyam and **Santhakumar Mohan**, HYBRID UNDERWATER VEHICLE FOR OCEAN OBSERVATIONS, India, 201821009575, 2018 (Published, The Patent Office Journal No. 14/2018 Dated 06/04/2018 page 12088)

Selected Journal Publications

(SCOPUS Author ID: 26434501600)

1. Divyansh Khare, Sandra C, **Santhakumar Mohan**, Investigation on design and control aspects of a new autonomous mobile agricultural fruit harvesting robot, Journal of Mechanical Engineering Science , Accepted (in press) (2022)
2. Isaac John, **Santhakumar Mohan**, Larisa Rybak, Numerical Investigations, development and control of a Cartesian (3-PRRR) parallel manipulator, Journal of Mechanical Engineering Science , Accepted (in press) (2022)
3. Ravi Prakash, Laxmidhar Behera, **Santhakumar Mohan** and S. Jagannathan, Dual Loop Optimal Control of a Robot Manipulator and its Application in Warehouse Automation, IEEE Transactions on Automation Science and Engineering 19 (1) 262-279, 2022
4. Parvathi Sunilkumar, **Santhakumar Mohan**, Jayant Kumar Mohanta, Philippe Wenger, Larisa Rybak, Design and motion control scheme of a new stationary trainer to perform lower limb rehabilitation therapies on hip and knee joints, International Journal of Advanced Robotic Systems 19 (Jan-Feb) 1-20 (2022)
5. Jeongae Bak, Yecheol Moon, Jongwon Kim, **Santhakumar Mohan**, Tae Won Seo, Sangrok Jin, Hovering control of an underwater robot with tilting thrusters using the decomposition and compensation method based on a redundant actuation model, Robotics and Autonomous Systems 150, 2022
6. Jagadeesh Kadiyam, **Santhakumar Mohan**, Devendra Deshmukh, Taewon Seo, Simulation-based semi-empirical comparative study of fixed and vectored thruster configurations for an underwater vehicle, Ocean Engineering 234 (August) 1-23, 2021
7. Ravi Prakash, Laxmidhar Behera, **Santhakumar Mohan**, Jagannathan Sarangapani, Dynamic Trajectory Generation and a Robust Controller to Intercept a Moving Ball in a Game Setting, IEEE Transactions on Control Systems Technology 28 (4) 1418 - 1432, 2020
8. Jagadeesh Kadiyam, Anjali Parashar, **Santhakumar Mohan**, and Devendra Deshmukh, Actuator fault-tolerant control study of an underwater robot with four rotatable thrusters, Ocean Engineering 187, 1-19, 2020
9. Vasanthakumar M, Vinod B, JK Mohanta and **Santhakumar Mohan**, Design and Robust Motion Control of a Planar 1P-2PRP Hybrid Manipulator for Lower Limb Rehabilitation Applications, Journal of Intelligent & Robotic Systems, 96, 17-30, 2019
10. Swati Mishra, Pandurang Londhe, **Santhakumar Mohan**, SK Vishwakarama and Balasaheb Patre, Robust task-space motion control of a mobile manipulator using a nonlinear control with an uncertainty estimator, Computers and Electrical Engineering, 67, 729-740, 2018
11. **Santhakumar Mohan**, Error analysis and control scheme for the error correction in trajectory-tracking of a planar 2PRP-PPR parallel manipulator, Mechatronics, 46, 70-83, 2017
12. Pandurang Londhe, **Santhakumar Mohan**, Balasaheb Patre, and Laxman Waghmare, Robust Task-Space Control of an Autonomous Underwater Vehicle-Manipulator System by PID-like Fuzzy Control Scheme with Disturbance Estimator, Ocean Engineering, 139, 1-13, 2017

13. **Santhakumar Mohan**, J.K. Mohanta, S.Kurtenbach, J. Paris, B.Corves and M. Huesing, Design, development and control of a 2PRP-2PPR planar parallel manipulator for lower limb rehabilitation therapies, *Mechanism and Machine Theory*, 112, 272-294, 2017
14. Pandurang Londhe, **Santhakumar Mohan**, Balasaheb Patre, and Laxman Waghmare, Task Space Control of an Autonomous Underwater Vehicle-Manipulator System by Robust Single-Input Fuzzy Logic Control Scheme, *IEEE Journal of Oceanic Engineering*, 42, 13-28, 2017
15. Pandurang S Londhe, Yogesh Singh, **Santhakumar Mohan**, Balasaheb Patre and Laxman M Waghmare, Robust Nonlinear PID-like Fuzzy Logic Control of a Planar Parallel (2PRP-PPR) Manipulator, *ISA Transactions*, 63, 218-232, 2016
16. **Santhakumar Mohan** and Jinwhan Kim, Coordinated motion control in task space of an autonomous underwater vehicle - manipulator system, *Ocean Engineering* 104, 155-167, 2015
17. Yogesh Singh and **Santhakumar Mohan**, Inverse dynamics and robust sliding mode control of a planar parallel (2-PRP and 1-PPR) robot augmented with a nonlinear disturbance observer, *Mechanism and Machine Theory* 92, 29-50, 2015
18. V.Vinoth, Yogesh Singh and **Santhakumar Mohan**, Indirect disturbance compensation control of a planar parallel (2-PRP and 1-PPR) robotic manipulator, *Robotics and Computer Integrated Manufacturing*, 30(5), 556–564, 2014
19. **Santhakumar Mohan** and T.Asokan, Power efficient dynamic station keeping control of an underactuated flat-fish type autonomous underwater vehicle through design modifications of thruster configuration. *Ocean Engineering* 58, 11-21, 2013
20. **Santhakumar Mohan** and Jinwhan Kim, Indirect adaptive control of an autonomous underwater vehicle-manipulator system for underwater manipulation tasks, *Ocean Engineering* 54, 233-243, 2012

Edited Books (as an Editor)

1. Dibakar Sen, **Santhakumar Mohan**, G.K. Ananthasuresh, *Mechanism and Machine Science, Select Proceedings of Asian MMS 2018, Lecture Notes in Mechanical Engineering*, Springer, 2020, ISBN: 978-981-15-4476-7
2. Neelesh Kumar Jain, I.A. Palani, B.K. Lad, **Santhakumar Mohan**, Anand Parey, *Robotics, Automation, Manufacturing and Industrial Engineering, Proceedings of 2nd International Conference on Intelligent Robotics, Automation and Manufacturing*, Emerald Group Publishing (India) Pvt. Ltd., 2013, ISBN: 978-099-2680-015
3. **Santhakumar Mohan**, S. Shankar, G. Rajeshkumar, *Materials, Design, and Manufacturing for Sustainable Environment*, Springer 2020, ISBN: 978-981-15-9809-8

Selected Conference Publications

1. J.K. Mohanta, **Santhakumar Mohan**, Y. Takeda, B. Corves, Adaptive Backstepping Motion Control of a New Sitting-type Lower Limb Rehabilitation Robot, *Advances in Mechanism and Machine Science. IFToMM WC 2019. Mechanisms and Machine Science 73 (Finalist, Best Paper Award)* 2761-2768 (2019)
2. Muralidharan M, **Santhakumar Mohan**, Task-space pose decomposition motion control of a mobile manipulator, *International Conference on Signals, Machines and Automation (SIGMA'18)*, NSIT Delhi, India, pp. 1-8, 2018 (**Best paper (session) award winner**)
3. **Santhakumar Mohan**, J. K. Mohanta, B. Corves, M. Hüsing, Dual-loop motion control for geometric errors and joint clearances compensation of a planar 2prp-ppr manipulator, *The 4th Conference on Mechanisms, Transmissions and Applications (MeTrApp 2017)*, Trabzon, Turkey, pp. 1-10, 2017
4. **Santhakumar Mohan**, Burkhard Corves, Philippe Wenger, Design Optimization and Accuracy Analysis of a Planar 2PRP-PPR Parallel Manipulator, *7th IFToMM International Workshop on Computational Kinematics (CK2017)*, Futuroscope-Poitiers, France, pp. 1-8, 2017
5. J. K. Mohanta, **Santhakumar Mohan**, Error Modelling and Sensitivity Analysis of a Planar 3-PRP Parallel Manipulator, *7th IFToMM International Workshop on Computational Kinematics (CK2017)*, Futuroscope-Poitiers, France, pp. 1-8, 2017

6. J. K. Mohanta, **Santhakumar Mohan**, S. Kurtenbach, B. Corves, M. Hüsing, Augmented PID Control of a 2PPR-2PRP Planar Parallel Manipulator for Lower Limb Rehabilitation Applications, The Joint International Conference of the XII International Conference on Mechanisms and Mechanical Transmissions (MTM) and the XXIII International Conference on Robotics (Robotics'16) Aachen, Germany, pp. 1-9, 2016
7. Anirban Nag, **Santhakumar Mohan** and Sandipan Bandyopadhyay, Forward Kinematic Analysis of the 3-RPRS Parallel Manipulator, 6th European Conference on Mechanism Science (Eucomes 2016), Nantes, France, pp. 1-8, 2016 (**Finalist, Best theoretical paper award**)
8. Jayant Kumar Mohanta, **Santhakumar Mohan**, Burkhard Corves, A 2PRP-2PPR Planar Parallel Manipulator for the Purpose of Lower Limb Rehabilitation, 6th European Conference on Mechanism Science (Eucomes 2016), Nantes, France, pp. 1-8, 2016 (**Finalist, Best application paper award**)
9. Yogesh Singh and **Santhakumar Mohan**, Kinematic Performance Analysis of a New 2PRP-PRR Planar Parallel Robotic Manipulator, The Fourth Joint International Conference on Multibody System Dynamics, Montreal, Canada, May-June, 2016
10. **Santhakumar Mohan** and Yogesh Singh, Task Space Position Tracking Control of an Autonomous Underwater Vehicle with Four Tilting Thrusters, IEEE/MTS OCEANS 2016, Shanghai, China, pp. 1-3, 2016
11. Jayant Kumar Mohanta, Chitransh Saxena, Gaurav Gupta and **Santhakumar Mohan**, Kinematic Analysis of a Passive Sitting/Lying type Lower Limb Rehabilitation Robot, 2nd international and 17th National Conference on Machines and Mechanisms, KANPUR, India, pp. 1-6, 2015
12. **Santhakumar Mohan** and Jinwhan Kim, Robust Nonlinear Proportional Integral Derivative Control for Position Tracking of an Underwater Manipulator, IEEE/ASME International Conference of Advances in Mechatronics (AIM 2015), Busan, ROK, July 2015.
13. V. Vinoth, **Santhakumar Mohan**, Jinwhan Kim, Disturbance Observer based Terminal Sliding Mode Control of an Underwater Manipulator, International Conference on Control, Automation, Robotics & Vision, Marina Bay Sands, Singapore, December, 2014.
14. V. Vinoth, Yogesh Singh, Jayant Kumar Mohanta, **Santhakumar Mohan**, Robust Disturbance Observer based Sliding Mode Control of a Planar Parallel (3-PPR) Manipulator, Students' Conference on Engineering and Systems (SCES 2014), Allahabad, India, May, 2014. (**Best paper (session) award winner**)
15. V. Vinoth, Yogesh Singh, **Santhakumar Mohan**, Inverse Kinematic Modelling of a 6-DOF (3-RPRS) Parallel Spatial Manipulator, The 3rd Joint International Conference on Multibody System Dynamics, Busan, South Korea, June-July, 2014.
16. **Santhakumar Mohan**, Yonghyun Kim and Jinwhan Kim, A Nonlinear Task space Tracking Control of an Underactuated Underwater Vehicle, IEEE the 9th International Conference on Ubiquitous Robots and Ambient Intelligence (URAI 2012), Daejeon, ROK, Nov 2012.
17. **Santhakumar Mohan** and Jinwhan Kim, Indirect Adaptive Control for Autonomous Underwater Vehicle-Manipulator Systems, the 22nd International Offshore (Ocean) and Polar Engineering (ISOPE 2012) Conference Rhodes, Greece, June 17 to 22, 2012.
18. **Santhakumar Mohan**, Yonghyun Kim and Jinwhan Kim, Power efficient trajectory tracking control of underactuated autonomous underwater vehicle-manipulator systems, IEEE / MTS OCEANS 2012, Yeosu, ROK, May 2012 .
19. **Santhakumar Mohan** and Jinwhan Kim, Modelling, simulation and model reference adaptive control of autonomous underwater vehicle-manipulator systems, IEEE International Conference on Control, Automation and Systems (ICCAS 2011), KINTEX, ROK, Oct. 26-29, 2011.
20. **Santhakumar Mohan** and T.Asokan, Coupled, non-linear control system design for autonomous underwater vehicle (AUV). IEEE International Conference on Control, Automation, Robotics and Vision (ICARCV 2008), Hanoi, Vietnam, Dec, 2008.

Research Supervision

Regular (Full-time) Research Students at IIT Palakkad

1. **Isaac John**, Hybrid robots (Joined PhD Program in July 2021)
2. **Arun Krishnan**, Underwater robots (Joined PhD program in December 2019)
3. **Parvathi Sunilkumar**, Assistive and rehabilitation robots (Joined MS program in July 2019, **Completed in July 2021**)

Regular (Full-time) PhD Students at IIT Indore

4. **Yogesh Singh**, Performance investigations on mechanical design and motion control of planar parallel manipulators (Joined July 2012, **Thesis defended** in December 2016)
5. **Jayant Kumar Mohanta**, Development and performance investigations of a sitting/lying type lower limb rehabilitation robot (Joined July 2014, **Thesis defended** in July 2018)
6. **Swati Mishra**, Motion control studies and performance investigations of a mobile manipulator (Joined July 2015, **Thesis defended in May 2020**)
7. **Jagadeesh Kadiyam**, Performance investigations on work-class and observation-class marine robotic vehicles (Joined January 2017, **Thesis defended in November 2021**)

Visiting (Other institution) Students

8. Pandurang Londhe, SGGGS IE & T, Nanded (Thesis defended in May 2018)
9. Meera C S, UPES Dehradun (Thesis defended in July 2020)
10. Ravi Prakash, IIT Kanpur (Thesis defended in Jan 2022)
11. Vasanthakumar M, PSG Tech., Coimbatore (Thesis defended in March 2022)

International M.S. students (Completed)

1. Yonghyun Kim, (Co-supervisor: Prof. Jinwhan Kim)
Institute: Korean Advanced Institute of Science and Technology, Daejeon, ROK
2. Francesco Alberto Orsini, Politecnico di Torino, Turin, Italy
Institute: RWTH Aachen University, Germany

Other Professional Activities

1. **Technical Editor**, IEEE/ASME Transactions on Mechatronics, 2021-2024
2. **Associate Editor**, IEEE Robotics and Automation Letters, 2021-2023
3. **Associate Editor**, ASME Letters in Dynamic Systems and Control, 2021-2023
4. **Associate Editor**, 30th IEEE International Conference on Robot and Human Interactive Communication, Vancouver, 2021, 29th IEEE International Conference on Robot and Human Interactive Communication, Naples Italy, 2020 and 28th IEEE International Conference on Robot and Human Interactive Communication – RO-MAN 2019, New Delhi, India, 2019.
5. **Publication chair**, International Conference on Materials, Design and Manufacturing for Sustainable Environment (ICMDMSE 2020), March 2020, Coimbatore, Tamil Nadu, India
6. **Publication co-chair**, International Conference on Advances in Robotics, June - July 2019, Chennai, Tamil Nadu, India.
7. **Publication co-chair**, Asian Conference on Mechanism and Machine Science, December 2018, Bangalore, Karnataka, India.
8. **Publication chair**, International Conference in Automation, Robotics and Sensing (ICAARS 2016, ICAARS 2018), June 2016 and December 2018, Coimbatore, Tamil Nadu, India
9. **Conference co-chair**, International Conference on Intelligent Robotics, Automation and Manufacturing (IRAM 2013), December 2013, Indore, Madhya Pradesh, India.