

K Madhava Krishna

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Research Interests:

- Mobile robotics, Robotic Vision, Outdoor Navigation, Mechanism Design, Multi-robotic Systems
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Education:

2001 November: Ph.D. from Electrical Engineering Dept, *Indian Institute of Technology at Kanpur*. The dissertation was on Soft Computing Applications to Real-time Navigation of Mobile Robots in Stationary and Dynamic Environments

1998 July: Masters in Electronics Engineering from *Birla Institute of Technology and Science at Pilani*

1996 July: Bachelors in Electrical Engineering from *Birla Institute of Technology and Science at Pilani*

Fellowships:

Post Doctoral Fellowship of the French Government at the Robotics and AI Lab, LAAS-CNRS, Toulouse starting January 15th 2002 for a period of one year.

Grants:

1. BRNS, "Vision based Localization and SLAM for Mobile Robots", 2012-2015, INR 2.5 million
2. Renault Nissan, "Independent Motion Detection", 2012 (3 months), INR 0.4 million
3. DST, "Vision based Algorithm for Outdoor Navigation", 2011-2014, INR 3 million
4. CAIR, "Autonomous Navigation for Outdoor Environments", 2010-2011, INR 1 million
- 5 CVRDE-DRDO, "Digital Terrain Modeling using Single Laser Systems", Feb 2008– Aug 2009, INR 1 million
6. BRNS, "SLAM Algorithms: Development and Testing for Autonomous Navigation", 2008-2011, INR 3 million
7. DRDO-Extra Mural, "Snake Robots for Search and Rescue", 2009-2011, INR 1.5 million
- 8.. MCIT, "Perceptual Engineering Project", 2009-2012

9. CAIR, "Development of Algorithms for Mobile Robot Navigation", 2006–2007, INR 1 million
10. DST, "Predictable Performance Algorithm for a Multi-robotic Surveillance System", 2005–2008, INR 0.8 million
11. The French Ministry of Research's grant for young foreign researchers: "Safe Proactive Plans and their Execution for a Personal Mobile Robot", US\$ 75000, 2002 – 2003, Co-PI
12. "Research in Evaluation Methods for Data Fusion Capable Tactical Platforms for Electronic Warfare and Information Warfare Related Missions", Air Force Office of Scientific Research (AFOSR), US\$ 25000, Aug. to Nov. 2004, Co-PI

Awards:

- Best Paper Award, in ICVGIP 2010 for the paper on, "Real-time Motion Segmentation Based Multibody VSLAM", coauthored with Abhijit Kundu and C V Jawahar
- Microsoft Young Researcher Award, 2008-09

PUBLICATIONS

Journals:

1. G Aditya, Vijay Eathakota, Arun K Singh and K Madhava Krishna, "**A Simulation Framework for Evolution on Uneven Terrains for Synchronous Drive Robot**", *accepted in Advanced Robotics Journal (Robotics Society of Japan)*
2. *Vijay P Eathakota, A K Singh and K Madhava Krishna, "Two Models of Force Actuator based Active Suspension Mechanisms for Mobility on Uneven Terrain", in Acta Astronautica, Elsevier*
3. Karthikeya Viswanath and K Madhava Krishna, "Towards Load Balanced Decongested Multi Robotic Traffic Control at Intersections", *Springer Journal of Intelligent Service Robotics, March 2009*
4. Shivudu Bhuvanagiri and K Madhava Krishna, "Motion in Ambiguity: Coordinated Active Global Localization for Multiple Robots", to appear in *Robotics and Autonomous Systems*
5. K. Madhava Krishna, R. Alami and T. Simeon, "Safe Proactive Plans and their Execution", *Robotics and Autonomous Systems*, **54 (2006) 244-255** (available online at www.sciencedirect.com)
6. A K Pandey and K Madhava Krishna, "Link Graph and Feature Chain based Robust Online SLAM for Fully Autonomous Mobile Robot Navigation System using Sonar Sensors", to appear in *Springer Verlag's LNCIS, 2007*.
7. K Madhava Krishna and Henry Hexmoor, "A framework for guaranteeing detection performance of a sensor network", *Integrated Computer-Aided Engineering Journal*, **Volume 12, Number 3 / 2005**, Pages: 305 – 317, IOS Press
8. K Madhava Krishna, Srinivas Chellappa, and H. Hexmoor, 2005. "Reactive Navigation of Multiple Moving Agents by Collaborative Resolution of Conflicts", *Journal of Robotic Systems*, **22(5)**, 249-269, Wiley Periodicals, Inc

9. K Madhava Krishna and Prem K Kalra, "Detection Tracking and Avoidance for Multiple Dynamic Objects", *Journal of Intelligent and Robotic Systems*, vol 33: 371-408 Apr 2002 Kluwer Academic
10. K Madhava Krishna and Prem K Kalra, "When does the Robot Perceive a Dynamic Object", *Journal of Robotic Systems* , 19(2), Feb. 2002, John Wiley
11. K Madhava Krishna and Prem K Kalra, "Perception and Remembrance of the Environment during Real-time Navigation for a Mobile Robot", *Robotics and Autonomous Systems*, 37(1): 25-51, Oct. 2001, Elsevier
12. K Madhava Krishna and Prem K Kalra, "Solving the Local Minima Problem for a Mobile Robot by Classification of Spatio-temporal Sensory Sequences", *Journal of Robotic Systems*, 17(10) : 549-564, Oct. 2000, John Wiley and Sons
13. K Madhava Krishna and Prem K Kalra, "Spatial Understanding and Temporal Correlation for a Mobile Robot", *Spatial Cognition and Computation*, 2(3), Dec. 2000, Kluwer Academic

Premier Conferences:

1. Rahul Namdev, K Madhava Krishna and C V Jawahar., "Motion Segmentation of Multiple Objects from a Freely Moving Monocular Camera", *ICRA 2012*
2. Abhijit Kundu, K Madhava Krishna and C V Jawahar, "Realtime Multibody Visual SLAM with a Smoothly Moving Monocular Camera", in *International Conference on Computer Vision (ICCV),oral*, Nov2011,Barcelona.
3. Vijay Eathakota, G Aditya and K Madhava Krishna, "Quasi-Static Motion Planning on Uneven Terrain for a wheeled mobile robot", in *IROS 2011, SF, CA*
4. Arun K Singh, K Madhava Krishna and Vijay Eathakota, "Planning Stable Trajectory on Uneven Terrain based on Feasible Acceleration Count", in *IEEE Intl Conference on Decision and Control,2011, Florida*
5. Piyooosh Muhija and K Madhava Krishna, "A Two Phase Recursive Tree Propagation based Framework for Multi-Robotic Exploration with Fixed Base Station Constraint", *IROS 2010*
6. Chetan Jakkoju, K Madhava Krishna and C V Jawahar, "An Adaptive Outdoor Terrain Classification Methodology using Monocular Camera", in *IROS 2010*
7. Aravindhan Krishnan and K Madhava Krishna, "A Visual Exploration Algorithm using Semantic Cues that Constructs Image based Hybrid Maps", in *IROS 2010*
8. A K Singh, Vijay P Eathakota, R K Namdev and K Madhava Krishna, "A Novel Compliant Rover for Rough Terrain Mobility", in *IROS 2010*
9. Aravindhan Krishnan and K Madhava Krishna, "Autonomous Image Based Exploration for Indoor Environments using Local Features", *AAMAS 2010 (short paper)*
10. Piyooosh Mukhija, Rahul Sawhney and K Madhava Krishna, "Multi Robotic Exploration with Communication Requirement to a Fixed Base Station", *AAMAS 2010 (short paper)*
11. "Moving Object Detection by Multi-View Geometric Techniques from a Single Camera Mounted Robot ", Abhijit Kundu and K Madhava Krishna. *IROS 2009*
12. 2. "On Fast Exploration in 2D and 3D Terrains with Multiple robots", Rahul Sawhney and K Madhava Krishna *AAMAS 2009*

13. Rahul Sawhney, Mahesh Mohan, K Srinathan and K M Krishna, "Reduced time fault tolerant paths for Multi-UAV coverage of 3D Terrains", *AAMAS*, 2008
14. Shivudu B and K M Krishna, "Coordination in Ambiguity: Actively Localizing Multiple Robots", *AAMAS*, 2008
15. Mahesh Mohan, Rahul Sawhney, K Madhava Krishna, K Srinathan and M B Srikanth, "Covering Hostile Terrains with Partial and Complete Visibilities: On Minimum Distance Paths", *IROS*, 2008
16. A. H. Abdul Hafez, S Bhuvanagiri, K Madhava Krishna and C V Jawahar, "On-line Convex Optimization based Solution for Mapping in VSLAM", *IROS 2008*
17. S Bhuvanagiri and K Madhava Krishna, "Coordinated Active Global Localization for Multiple Robots by Disambiguating Multiple Hypotheses", *IROS 2008*
18. A K Pandey and K Madhava Krishna, "Integrating features onto an occupancy grid for sonar based safe mapping", *IJCAI (International Joint Conference on AI) 2007* ; <http://www.ijcai.org/papers07/contents.php>
19. Ganesh P Kumar and K Madhava Krishna, "Optimal Multi Target Detection by Multiple Sensors by Moving to the Maximal Clique in a Covering Graph", *IJCAI 2007, accepted (oral presentation)*; <http://www.ijcai.org/papers07/contents.php>
20. Siddharth Sanan, Darshan Santani, K Madhava Krishna and Henry Hexmoor, "Extension of Reeds and Shepp Paths for a Robot with Front and Rear Wheel Steer", *Proc of ICRA*, 2006
21. K Madhava Krishna and Henry Hexmoor, "A T Step Ahead Optimal Tracking Algorithm for a Surveillance Based Sensor Network", *In Proceedings of IEEE/RSJ International Conference on Intelligent Robot and Systems, Pages 1840-1845, Edmonton, CA*
22. K. Madhava Krishna and Henry Hexmoor "Reactive Collision Avoidance of Multiple Moving Agents by Cooperation and Conflict Propagation", *Proc. of ICRA, (IEEE Intl. Conf. on Robotics and Automation)*, New Orleans, April 2004
23. K Madhava Krishna, R Alami and T Simeon "Moving Safely but not Slowly: Reactively Adapting Paths to Better Time-lengths", *published in proceedings of ICAR (IEEE Intl Conf on Advanced Robotics)*, Coimbra, Portugal, Jun 2003
24. R Alami, T Simeon and K Madhava Krishna, "On the influence of sensor capacities and environment dynamics onto collision free motion plans", *proceedings of IROS (IEEE-RSJ Intl Conf on Intelligent Robotics and Systems)*, Sep. 2002
25. I J Nagrath, L Behera, K Madhava Krishna and K D Rajasekhar, "Real-time Navigation of a Mobile Robot using Kohonen's Topology Conserving Neural Networks", *Proc. IEEE Eighth International Conference on Advanced Robotics*, pp 459-464, Monterey, CA, July 1997

Other Refereed Conferences:

1. MDP based Active Localization for multiple robots Jyotika Bahuguna, B Ravindran and K Madhava Krishna. To appear in CASE 2009
2. On Measurement Models for Line Segments and Point Based SLAM Satish Pedduri, Gururaj Kosuru, K Madhava Krishna and Amit K Pandey ICAR 2009
3. Estimating Ground and Other Planes from a Single Tilted Laser Range Finder for On-Road Driving Yasovardhan Reddy E, Hemanth Korrapati and K Madhava Krishna ICAR 2009

- 4 Global Localization of Mobile Robots by Reverse Projection of Sensor Readings Hemanth Korrapati, K Madhava Krishna and Aditya Teja *ROBIO 2008*
- 5 A Mixed Autonomy Coordination Methodology For Multi-Robotic Traffic Control Aditya Teja V, D V Karthikeya Viswanath and K Madhava Krishna *ROBIO 2008*
6. Rakesh Goyal, K Madhava Krishna and Shivudu Bhuvanagiri, "Sensor Based Localization for Mobile Robots by Exploration and Selection of Best Direction", *accepted at Robio, IEEE/RSJ Intl' Conference on Robotics and Biomimetics*
7. A K Pandey and K Madhava Krishna, "Link Graph and Feature Chain based Robust Online SLAM for Fully Autonomous Mobile Robot Navigation System using Sonar Sensors", *Proceedings of ICAR 2007*
8. Satish Pedduri and K Madhava Krishna, "Collision Avoidance for Multiple Robots through Collision Free Paths till Next Waypoints from Collision Free Polygons", *Proceedings of ICAR 2007*
9. Karthikeya Viswanath and K Madhava Krishna, "Sensor Network Mediated Multi Robotic Traffic Control in Indoor Environments", *Proceedings of ICAR 2007*
10. Shivudu Bhuvanagiri, K Madhava Krishna and Rakesh Goyal, "Active Localization of Multiple Robots by Moving to Best Frontiers", *Proceedings of ICAR 2007*
11. Siddharth Sanan, Nageshwara Rao, K Madhava Krishna and Sartaj Singh, "On Improving the Mobility of Vehicles in Uneven Terrain", *Proceedings of ICAR 2007*
12. Ganesh P Kumar, K Madhava Krishna and P Menezes, "Multi-target Detection by Multi-sensor Systems: A Comparison of Systems", *accepted at Robio, accepted at Robio, IEEE/RSJ Intl' Conference on Robotics and Biomimetics*
13. K Madhava Krishna and Henry Hexmoor, "An Unconstrained Optimal Target Detection Algorithm for a Multi-Sensor Surveillance Systems", *IICAI, 2005*.
14. K Madhava Krishna, Henry Hexmoor and Subbarao, "Parametric Control of Multiple Unmanned Air Vehicles over an Unknown Hostile Habitat", *Proc of IEEE KIMAS, Boston, MA 2005*
15. K Madhava Krishna and Henry Hexmoor, "Resource Allocation Strategies for a Multi-sensor Surveillance System", submitted to *Conference on Collaborative Agents, Beijing 2004*
16. K Madhava Krishna and Henry Hexmoor, "A Framework for Measuring the Tracking Performance of a Sensor Network", *Proc. of PerMis'04 (Performance Metrics in Intelligent Systems), Aug 2004, Gaitesburg, MD*
17. K. Madhava Krishna, Henry Hexmoor and P Subbarao, "Role of Autonomy in a Distributed Sensor Network for Surveillance", *Proc. of ICAI 2004, (Intl Conf. on Artificial Intelligence), Las Vegas, July 2004*.
18. K. Madhava Krishna, Henry Hexmoor, P Subba Rao and S Chellapa, "A Surveillance System based on Multiple Mobile Sensors", *Proc. of FLAIRS 2004, Special Track on AI Techniques in Multi-sensor Fusion, Miami, May 2004*
19. K. Madhava Krishna, Henry Hexmoor and P Subba Rao, "Avoiding Collision Logjams through Cooperation and Conflict Propagation", *IEEE KIMAS'03 (International Conference on Knowledge Integrated Multi Agent Systems), Boston, MA, Oct 1-3, 2003*
20. K. Madhava Krishna and Henry Hexmoor, "Towards Quantification of the need to Cooperate between Robots", *Proceedings of PerMIS'03 (Performance Metrics in Intelligent Systems), Sep. 16-18, 2003*

21. K. Madhava Krishna and Henry Hexmoor, "Social Control of a Group of Collaborating Multi-robot Multi-target Tracking Agents", *IEEE, AIAA 22nd Digital Avionics Systems Conference*, Indianapolis, Indiana, Oct. 12-16, 2003.

22. Henry Hexmoor and K Madhava Krishna, "Collaborative and Social Reasoning about Interaction among a Large Group of Robots", *International Symposium on Collaborative Technologies and Systems*, San-Diego, CA, Jan. 18-23, 2004

23. K Madhava Krishna, K D Rajasekhar and L Behera, "On Fast Computation of Optimal Paths from the Visibility Graph for the Minimal Workspace", *Proc. International Symposium on Intelligent Robotic Systems*, pp 147-154, Bangalore, INDIA, Jan 1998.

Software Skills:

- Versatile in C with more than ten-year experience starting from August of 1993
 - Experienced in Java 2, TCL/TK toolkit and C++.
 - Versatile in MATLAB with experience on the neural network and fuzzy logic toolbox.
 - 8751 Assembly Language Programming (ALP), 8086 ALP, TMS320C5X 16bit fixed point DSP's ALP
 - Familiar with MS Windows, Solaris, Linux OS
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Hardware Experiences:

- Real-time control of Mobile Robots like XR-4000 NOMADIC, Active Media's AMIGOBOTS, LABMATE and ROVER
 - Hardware interfaces with PC's (Pentium 130 MHz) and 8051 microcontrollers
 - Interfaces with TMS320C5X 16 bit fixed point DSP
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Industrial Projects:

- **Microcontroller (8751) based Product Mixer for Process Industry:**

Here a 8751 embedded controller based key board interface was designed, developed and implemented for the Central Electronics Engineering Research Institute at Madras during the summer of 94.

- **Design and Development of a Frequency Modulated File Transfer Protocol between Remote Terminals:** This project was done during the Spring of 1996 for Amsoft Systems Pvt. Limited at New Delhi for facilitating wireless transfer of data in semi duplex mode between two remote PCs acting as dumb terminals.
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Service:

- Reviewer for IEEE Intl Conference on Robotics and Automation 2005, 2007
- Member IEEE
- Organized IROCHA, a Robotic Competition involving robotic system development and computer vision
- Organized a workshop, "Societal Applications for Multi Robotic Systems" as part of IJCAI.