

- **Visiting Assistant Professor of Mechanical Engineering** *2011*
Division of Physical Sciences & Engineering, KAUST, Saudi Arabia
- **Visiting Researcher** *July 2010*
Automatic Control Laboratory, ETH-Zurich, Switzerland
- **Visiting Researcher** *Dec 2004*
Department of Mathematics, Stanford University
- **Visiting Researcher** *June 2004*
Department of Mathematics, University of Illinois, Urbana-Champaign

Publications

Books / Edited Volumes

2. "Field and Assistive Robotics: Advances in Systems & Algorithms," Editors: Karsten Berns, Syed Atif Mehdi, **Abubakr Muhammad**, Shaker Verlag, Germany, 2014.
1. "Graphs, Simplicial Complexes and Beyond: Topological Tools for Multiagent Coordination," **Abubakr Muhammad**, VDM Verlag, Germany, 2008.

Journal Articles

2. Kamil Bradler, Nicolus Dutil, Patrick Hayden and **Abubakr Muhammad**, "Conjugate Degradability and the Quantum Capacity of Cloning Channels," Journal of Mathematical Physics, Vol. 51, Issue 7, 2010.
1. **Abubakr Muhammad** and Magnus Egerstedt, "Connectivity Graphs as Models of Local Interactions," Journal of Applied Mathematics and Computation, Vol. 168, Issue 1, September 2005, Pages 243–269.

Book Chapters

7. Talha Manzoor and **Abubakr Muhammad**, "Investigating the Observability of Monocular SLAM: Obscured Beacons and Disparity Measurements." Field and Assistive Robotics: Advances in Systems and Algorithms, Shaker Verlag, 2014.
6. **Abubakr Muhammad**, Syed M. Abbas, Talha Manzoor, Adnan Munawar, Syed A. Abbas, Mhequb Hayat, Ali Abbas, Mian M. Awais, "Marwa: A Rough Terrain Landmine Detection Robot For Low Budgets". Field and Assistive Robotics: Advances in Systems and Algorithms, Shaker Verlag, 2014.
5. Zahoor Ahmad, Ehsan U. Asad, **Abubakr Muhammad**, Waqas Ahmad and Arif Anwar, "Development of a Low-Power Smart Water Meter for Discharges in Indus Basin Irrigation Network", Wireless Sensor Networks for Developing Countries, Springer Communications in Computer and Information Science (CCIS), Volume 366, 2013.
4. **Abubakr Muhammad** and Ali Jadbabaie, "Dynamic coverage verification in Mobile Sensor Networks Via Switched Higher Order Laplacians," in Oliver Broch, (Editor), Robotics: Science and Systems, MIT Press, 2007.
3. **Abubakr Muhammad** and Ali Jadbabaie, "Asymptotic Stability of switched higher order Laplacians and dynamic coverage", in Alberto Bemporad, Antonio Bicchi and Giorgio Buttazzo (Editors), Hybrid Systems: Computation and Control, Springer Lecture Notes in Computer Science (LNCS), 2007.
2. **Abubakr Muhammad**, Meng Ji and Magnus Egerstedt, "Applications of Connectivity Graph Processes in Networked Sensing and Control," Networked Embedded Sensing and Control, Springer Lecture Notes in Control and Information Sciences (LNCIS), 2006.

1. **Abubakr Muhammad** and Magnus Egerstedt, "Decentralized Coordination With Local Interactions: Some New Directions," Cooperative Control, Springer Lecture Notes in Control and Information Sciences (LNCIS), Vol. 309, 2005.

Peer-Reviewed Conference Papers

39. Hamza Anwar, **Abubakr Muhammad**, Karsten Berns, Towards Performance Limits of Aerial Canal Inspection. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Hamburg, Germany. 2015.
38. Talha Manzoor, **Abubakr Muhammad**, "An Extension of the Kalman Filter for a Class of Measurement Models Inspired by Wide-Baseline Stereo." European Control Conference (ECC), Linz, Austria, July 2015.
37. N.M. Phuong, M. Schappacher, A. Sikora, Zahoor Ahmad, **Abubakr Muhammad**, "Real-time Water Level Monitoring Using Low-Power Wireless Sensor Network", Embedded World Conference 2015, Nuremberg, 24.-26. Feb. 2015.
36. Ch.Ammad Rehmat, **Abubakr Muhammad**, Naveed ul Hassan, "A Model Driven Framework for Risk Mitigation in Irrigation Networks". Climate Change in Pakistan, IDRC-CRDI Working Paper Series #2, 2014.
35. Zahoor Ahmad and **Abubakr Muhammad**, "Low Power Hydrometry for Open Channel Flows", 40th Annual Conference of the IEEE Industrial Electronics Society (IECON), Dallas, USA, 2014.
34. Saad Aleem, Hasan Nasir, **Abubakr Muhammad**, "System Identification of Distributory Canals in the Indus Basin." 19th World Congress of the International Federation of Automatic Control (IFAC 2014), Cape Town, South Africa, 24-29 August 2014.
33. Talha Manzoor, Sergey Aseev, Elena Rovenskaya, **Abubakr Muhammad**, "Optimal Control for Sustainable Consumption of Natural Resources." 19th World Congress of the International Federation of Automatic Control (IFAC 2014), Cape Town, South Africa, 24-29 August 2014.
32. Hamza Anwar, Syed Muhammad Abbas, **Abubakr Muhammad**, Karsten Berns, "Volumetric Estimation of Contained Soil using 3D Sensors", 3rd International Commercial Vehicle Technology Symposium (CVT), Kaiserslautern, Germany, 2014.
31. Talha Manzoor and **Abubakr Muhammad**, "Disparity as a Separate Measurement in Monocular SLAM", IEEE International Conference on Robotics and Biomimetics (Robio), Shenzhen, China, December 12 - 14, 2013.
30. Usama bin Sikandar and **Abubakr Muhammad**, "Modeling and Simulation of Surface-and-dive Behavior of a Bottlenose Dolphin," IEEE International Conference on Robotics and Biomimetics (Robio), Shenzhen, China, December 12 - 14, 2013.
29. Syed Muhammad Abbas, **Abubakr Muhammad**, Syed Atif Mehdi and Karsten Berns, "Improvements in Accuracy of Single Camera Terrain Classification", 16th International Conference on Advanced Robotics (ICAR), Montevideo, Uruguay, November 25-29th, 2013.
28. Zahoor Ahmad and **Abubakr Muhammad**, "Design, Calibration and Performance of a Low-Power Wireless Sensor Node for Open Channel Flows", 39th Annual Conference of the IEEE Industrial Electronics Society (IECON), Vienna, Austria, 2013.
27. Talal Ahmed, Momin Uppal, and **Abubakr Muhammad**, "Improving Efficiency and Reliability of Gunshot Detection Systems", 38th IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Vancouver, Canada, May 26 - 31, 2013.

26. Zaeem Hussain and **Abubakr Muhammad**, “Sample size reduction in groundwater surveys via sparse data assimilation,” IEEE International Conference on Networking, Sensing and Control (ICNSC), Paris-Evry University, France 2013.
25. Hasan Nasir and **Abubakr Muhammad**, “Locating Leaks & Dumps in Open Channels with Minimal Sensing,” IEEE Conference on Control Applications (CCA), Dubrovnik, Croatia 2012.
24. **Abubakr Muhammad**, “Optimal Simplex Distribution in Homological Sensor Networks,” Mathematical Theory of Networks and Systems (MTNS), Melbourne, Australia, 2012.
23. Talha Manzoor, Adnan Munawar and **Abubakr Muhammad**, “Visual Servoing for Landmine Detecting Robot Marwa”, 7th German Conference on Robotics (Robotik), Munich, Germany, 2012.
22. Syed M. Abbas and **Abubakr Muhammad**, “Outdoor RGB-D SLAM Performance in Slow Mine Detection”, 7th German Conference on Robotics (Robotik), Munich, Germany, 2012.
21. Muhammad Umer Tariq, Hasan Arshad Nasir, **Abubakr Muhammad** and Marilyn Wolf, “Model-Driven Performance Analysis of Large Scale Irrigation Networks.” ACM/IEEE International Conference on Cyber Physical Systems (ICCPS), Beijing, China, 2012.
20. Hasan Nasir and **Abubakr Muhammad**, “Feedback Control of Very-Large Scale Irrigation Networks: A CPS Approach in a Developing-World Setting.” 18th World Congress of International Federation of Automatic Control (IFAC), Milano, Italy, 2011.
19. Mhequb Hayat and **Abubakr Muhammad**, Spectral Properties of Expansive Configuration Spaces: An Empirical Study. IEEE International Conference on Robotics and Automation (ICRA 2011), Shanghai, China. May 9-13, 2011.
18. Ishtiaq Maqsood, Hasan Nasir and **Abubakr Muhammad**, PID Controller Tuning for Network Delayed Motion Control. International Conference on Communications, Computing and Control Applications (CCCA11), Hammamet, Tunisia, March 3-5, 2011.
17. Mhequb Hayat and **Abubakr Muhammad**, “Spectral Metrics for Expansive Configuration Spaces”, The Ninth International Workshop on the Algorithmic Foundations of Robotics (WAFR), Singapore, 13-15 Dec 2010.
16. **Abubakr Muhammad**, Distributed Electrical Power Distribution Using Evolutionary Variational Inequalities, Mathematical Theory of Networks and Systems (MTNS), Budapest, Hungary, 2010.
15. Hassan Mohy-ud-Din and **Abubakr Muhammad**, “Detecting Narrow Passages in Configuration Spaces Via Spectra of Probabilistic Roadmaps”, ACM Symposium on Applied Computing, Sierre, Switzerland, 2010.
14. **Abubakr Muhammad**, “Sensor Selection and Motion Planning in Robotic Sensor Networks Under Communication Constraints”, Control and Decision Conference (CDC), 2008.
13. **Abubakr Muhammad** and Ali Jadbabaie, “Decentralized Computation of Homology Groups in Networks by Gossip”, American Control Conference, 2007.
12. **Abubakr Muhammad** and Magnus Egerstedt, “Control Using Higher Order Laplacians in Network Topologies,” Mathematical Theory of Networks and Systems, Kyoto, Japan, 2006.
11. **Abubakr Muhammad** and Magnus Egerstedt, “Network Configuration Control Via Connectivity Graph Processes,” American Control Conference, Minneapolis, 2006.
10. Meng Ji, **Abubakr Muhammad** and Magnus Egerstedt, “Leader-Based Multi-Agent Coordination: Controllability and Optimal Control,” American Control Conference, Minneapolis, 2006.

9. **Abubakr Muhammad** and Magnus Egerstedt., “Positivstellensatz Certificates For Feasibility Of Connectivity Graphs In Multi-Agent Formations,” 16th IFAC World Congress, Prague, July 4-8, 2005.
8. Vin de Silva, Robert Ghrist and **Abubakr Muhammad**, “Blind Swarms for Coverage in 2-D,” Robotics: Science and Systems, Massachusetts Institute of Technology, Cambridge, MA, June 8-11, 2005.
7. Robert Ghrist and **Abubakr Muhammad**, “Coverage And Hole-Detection In Sensor Networks Via Homology,” The Fourth International Conference on Information Processing in Sensor Networks (IPSN’05), UCLA, Los Angeles, CA, April 25-27, 2005.
6. **Abubakr Muhammad** and Magnus Egerstedt, “Connectivity Graphs as Models of Local Interactions,” IEEE Conference on Decision and Control, Bahamas, December 2004.
5. **Abubakr Muhammad** and Magnus Egerstedt, “On The Structural Complexity Of Multi-Agent Robot Formations,” American Control Conference, Boston, Massachusetts, USA, July 2004.
4. **Abubakr Muhammad** and Magnus Egerstedt, “Topology And Complexity Of Formations,” in Proceedings of 2nd International Workshop on the Mathematics and Algorithms of Social Insects, Atlanta, Georgia, USA, December 15-17, 2003.
3. Henrik Axelsson, **Abubakr Muhammad**, and Magnus Egerstedt, “Autonomous Formation Switching For Multiple, Mobile Robots,” in Proceedings of IFAC Conference on Analysis and Design of Hybrid Systems, Sant-Malo, Brittany, France, June 2003.
2. Magnus Egerstedt, **Abubakr Muhammad**, and X. Hu, “Formation Control Under Limited Sensory Range Constraints,” in Proceeding of 10th Mediterranean Conference on Control and Automation, Lisbon, Portugal, July 2002.
1. **Abubakr Muhammad**, Biological Receptive Fields for Motion Detection, FAST-IEEE Student Conference on CS and IT, FISC’ 98, Lahore, Pakistan, 1998.

Presentations/Invited Talks/Seminars (Selected)

- o IEEE RAS Summer School on Agricultural Robotics, University of Sydney 2015
- o International Institute of Advanced Systems Analysis (IIASA), Vienna 2014
- o Commercial Vehicle Technology Symposium (CVT), Kaiserslautern March 2014
- o Conference on Water for Food Security: Challenges for Pakistan, Islamabad Dec 2013
- o Institute of Robotics & Mechatronics, German Aerospace Center (DLR), Munich July 2013
- o IEEE Int. Conference on Networked Sensing & Control (ICNSC), Paris April 2013
- o IEEE Multi-conference on Systems and Control (MSC), Dubrovnik, Croatia Oct 2012
- o Mathematical Theory of Networks and Systems (MTNS), Melbourne, Australia July 2012
- o Department of Electrical Engineering, University of Melbourne, Australia July 2012
- o Hydrometry & control for distributory canals, PMIU, Punjab Irrigation Dept Feb 2012
- o CIMPA Workshop on Uncertainty Quantification, KAUST, KSA Jan 2012
- o IEEE International Conference on Robotics & Automation (ICRA), Shanghai May 2011
- o SimIndus: Modeling the Indus Basin, Planning Commission, Islamabad April 2011

◦ National Symposium on Quantum Information (NSQIP), Islamabad	April 2011
◦ Mathematical Theory of Networks and Systems (MTNS), Budapest, Hungary	July 2010
◦ ACM SAC 2010, Sierre, Switzerland	March 2010
◦ International Scientific Spring (ISS), NCP, Islamabad	March 2010
◦ Department of Computer Science, Stanford University	Aug 2008
◦ 7th McGill-INRIA Workshop on Computational geometry, Barbados	Jan 2008
◦ Decision and Control Seminar, CSL, UIUC	Nov 2006
◦ Mathematical Theory of Networks and Systems (MTNS), Kyoto, Japan	July 2006
◦ Systems and Controls Seminar, Georgia Tech	April 2006
◦ Networked Enabled Sensing and Control (NESC), Notre Dame	Sept 2005
◦ GRASP Lab Seminar, University of Pennsylvania, Philadelphia, PA	Sept 2005
◦ Department of Mathematics, Georgia Institute of Technology, Atlanta, GA	July 2005
◦ Information Processing in Sensor Networks (IPSN), Los Angeles, CA	Apr 2005
◦ Stanford University Topology Seminar, Palo Alto, CA	Dec 2004
◦ 43rd Control and Decision Conference, Bahamas	Dec 2004
◦ American Mathematical Society (AMS) Sectional Meeting, Evanston, IL	Oct 2004
◦ American Control Conference, Boston, MA	July 2004
◦ 2nd Workshop on Mathematics and Algorithms of Social Insects, Atlanta, GA	Dec 2003

Research Funding Won

19. Center for Water Informatics & Technology, 2015-16 Nestle-Pakistan seed grant for Center Establishment (PI)	\$100,000
18. Safe Roadmaps: Vehicle-specific Traversability & Safety Verification, 2015 LUMS FIF grant (PI)	\$9,500
17. IEEE-CSS Outreach Fund, 2015. IEEE Control Systems Society (CSS) grant (PI)	\$10,000
16. Robotic Profiling for Clearing Watercourses (RoPWat), 2014-16 DAAD Grant with University of Kaiserslautern, Germany (PI)	\$110,000
15. Canal Drones: Precise 3D Profiling of Siltation in Waterways, 2014 LUMS FIF grant (PI)	\$7,500
14. Options for effective water governance in Pakistans IBIS (WatGov), 2013-14 International Water Management Institute (IWMI), Pakistan Office (PI)	\$25,000
13. IIASA-Pakistan collaboration, 2012-13 Planning Commission, Government of Pakistan (co-PI)	\$130,000
12. Self Assembly of Hexagonal Structures, 2013-14 Higher Education Commission (HEC), Pakistan (co-PI)	\$17,000

11. Energy Autarkic and Autonomous Wireless Sensor System for Real Time Monitoring of Large Scale Waterways, 2013-15	\$110,000
DAAD Grant with University of Applied Sciences, Offenburg, Germany (co-PI)	
10. Revitalizing Irrigation in Pakistan, 2012-2014	\$110,000
International Water Management Institute (IWMI), Pakistan Office (PI)	
9. Hydrodynamic Data Assimilation for Contamination Monitoring, 2012-2014	\$25,000
Environment Protection Agency (EPA), Govt of Punjab (PI)	
8. Autonomous Land Vehicles for Agriculture and Demining, 2011-13	\$110,000
DAAD Grant with TU Kaiserslautern, Germany (PI)	
7. Testbed for Smart Water Grids, 2012	\$6,500
LUMS FIF grant (PI)	
6. IEEE-CSS outreach Fund, 2011.	\$10,000
IEEE Control Systems Society (CSS) grant (PI)	
5. Acoustic tracking of Indus river Dolphins, 2010-12	\$10,000
World Wildlife Fund (WWF), Pakistan (PI)	
4. Mine detection robotics, 2010-11	\$38,500
National Instruments, Arabia Division (PI)	
3. 3D Terrain mapping for robotics, 2010-11	\$10,000
LUMS FIF Grant (co-PI)	
2. Unmanned ground robotics, 2010-11	\$10,000
LUMS FIF Grant (PI)	
1. Research startup, 2008-11	\$30,000
LUMS Faculty Grant (PI)	

Teaching Experience

- EE-562, *Robot Motion Planning* [28#] LUMS Fall 2015, Spring 2014
- EE-561, *Digital Control Systems* [48#] LUMS Fall 2013,-2014
- EE-662, *Parameter & State Estimation* [8#] LUMS Spring 2013
- CS-xxx, *Mobile Robotics (3-week Module on SLAM)* [20#] TUKL Summer 2012,-13
- CMPE-633c, *Geometric Mechanics & Control* [12#] LUMS Spring 2012
- CMPE-633b, *Robot Dynamics & Control* [20#] LUMS Fall 2011
- ME-410, *Probabilistic Robotics* [10#] KAUST Summer 2011
- MATH-522, *Advanced Graph Theory* [10#] LUMS Spring 2010,-14
- EE-361: *Feedback Control Systems* [110#, 2 Sections] LUMS Spring 2010,-11,-12, -13, -14
- EE-361L: *Feedback Control Systems Lab* [110#, 4 Sections] LUMS Spring 2011,-12, -13, -14
- EE-210: *Signals and Systems* [110#, 2 Sections] LUMS, Spring 2010,11
- EE-241: *Introductory Electronics Laboratory* [120#, 4 Sections] LUMS, Fall 2009,-10
- Bio-103: *Freshman Biology (Systems Biology Module)* [160] LUMS, Spring 2009,-10
- CS-683: *Information theory* [8#] LUMS, Spring 2009

- COMP-208: *Computers for Engineering* [45#] McGill, Winter 2008
- Reading Gp. *Computational topology* (Lead) McGill, Winter 2008
- ECE-6553: *Optimal Control* (Teaching Assistant) Georgia Tech, Spring 2005
- ECE-6550: *Linear Control Systems* (Teaching Assistant) Georgia Tech, Fall 2005

Graduate Research Supervision Experience

- Talha Manzoor. PhD (EE) thesis
Optimal Control of Resource Networks. LUMS, 2013-present
- Syed Muhammad Abbas. PhD (EE) thesis
Autonomous Aerial Canal Mapping. LUMS, 2013-present
- Mudassir Khan. PhD (EE) thesis
Vehicle Specific Road Traversability Analysis LUMS, 2012-present
- Zaeem Hussein. MS (CS) thesis
Sparse Data Assimilation for Groundwater models LUMS, 2011-12
- Maryam Javed. MS (EE) thesis
Data Assimilation of Contamination Surveys in Hydrodynamic Models LUMS, 2012-13
- Faiz Alam. MS (CMPE) thesis
WiFi Signal Strength Based Robot Localization and Mapping. LUMS, 2011-13
- Bilal Talat. MS (EE) thesis
Visual Servoing of a Landmine-Detecting mobile Manipulator LUMS, 2012-13
- Talha Manzoor. MS (CMPE) thesis
Vision based SLAM algorithms for Unmanned ground vehicles. LUMS, 2011-13
- Syed Muhammad Abbas. MS (CS) thesis
Performance Metrics for Low-cost Field Robots. LUMS, 2011-13
- Hasan Arshad Nasir. MS (CMPE) thesis
Cyber-Physical Control for Large-scale Irrigation Networks LUMS, 2009-11
- Mhequb Hayat MS (CMPE) thesis
Spectral Analysis of Probabilistic Roadmaps LUMS, 2009-11

Awards and Honors

- Lead winning team, National Instruments Mine Detection Robot Design contest (2011).
- Selected as Jr Associate Member for ICTP, Trieste Italy (2011-2016)
- Award for Outstanding Service to EE program (2008-2010 at LUMS)
- Sigma Xi Best PhD thesis award (all science & engineering disciplines at Georgia Tech, 2006)
- Gold medalist, SSC examination (1/150,000 candidates in Lahore Board, 1992)
- Silver medalist, HSSC examination (2/74,000 candidates in Lahore Board, 1994)
- National Talent Scholarship recipient, 1990, 1992, 1994, 1995-2000

Professional Services

- Conference Secretary & Principal organizer, Four day International Workshops on Intelligent Water Grids (IWG), LUMS, 2013.

- co-Chair organizing committee, Six Workshops on Field & Assistive Robotics (WFAR), Lahore/Dagstuhl, Fa2011, Su2012, Fa2012, Su2013, Fa2013, Su2014.
- Convener, Graduate Program Committee, Dept of Electrical Engineering, LUMS (2013-2014)
- Convener, University Research Council, LUMS, 2013.
- Vice President Academics, IEEE Control Systems Society Pakistan chapter (2011-present).
- Secretary NMO, IIASA-Pakistan Collaboration (2012-2015).
- Member program committee : First International Conference on Robot Communication and Coordination (Robocomm 2007), Athens, Greece.
- Member program committee : Second International Conference on Robot Communication and Coordination (Robocomm 2009), Odense, Denmark.
- Member, organizing committee, Eighth Canadian Summer School on Quantum Information, Montreal, 2008.
- Graduate-track Coordinator for Georgia Tech Robotics Initiative Workshop 2003
- Reviewer for IEEE Transactions on Automatic Control, IEEE transactions on Robotics, IEEE transactions on Information theory, Automatica.
- Reviewer for various conferences and workshops (CDC, ACC, CAA, RSS, ICRA, SODA).
- Member IEEE since 1995. Member IEEE Control Systems Society, IEEE Robotics & Automation Society.
- Member American Mathematical Society (AMS).

References

- Dr Magnus Egerstedt, Schlumberger Professor of Electrical & Computer Engineering, Georgia Institute of Technology, Atlanta, GA (PhD Adviser) magnus@ece.gatech.edu
- Prof. Dr. rer. nat. Karsten Berns, Professor of Computer Science, University of Kaiserslautern, Germany (Collaborator) berns@informatik.uni-kl.de
- Dr Ali Jadbabaie, Alfred Fitler Moore Professor of Network Science, Department of Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, PA (Postdoc supervisor) jadbabai@seas.upenn.edu
- Dr Robert Ghrist, Andrea Mitchell University Professor, Department of Mathematics, University of Pennsylvania, Philadelphia (Collaborator) ghrist@math.upenn.edu
- Dr Patrick Hayden, Professor of Physics, Stanford University, CA (Postdoc supervisor) phayden@stanford.edu
- Dr Shahid Masud, Associate Professor & Chair, Department of Electrical Engineering, LUMS, Pakistan smasud@lums.edu.pk