

MUHAMMAD USMAN

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Network for Computational Nanotechnology (NCN),

Purdue University, School of Electrical and Computer Engineering,

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EDUCATION:

- 2005-2010** **Ph.D. degree in Electrical Engineering** POS CGPA=4.0/4.0
Purdue University, West Lafayette IN, USA
Thesis Advisor: Prof. Dr. Gerhard Klimeck
Thesis Title: Single and Coupled Quantum Dots for Optics and Quantum Information Processing
- 2003-2005** **M.Sc. degree in Electrical Engineering** (Oct. 2003 – Feb. 2005) Aggregate average = 80%
University of Engineering & Technology Lahore Pakistan
Thesis Advisor: Prof. Dr. Noor M. Sheikh
Thesis Title: Performance analysis of Adaptive Source Rate Control (ASRC) algorithm for VoIP.
- 1999-2002** **B.Sc. degree in Electrical Engineering** (Jan. 1999 – Dec. 2003) Aggregate average = 87%
University of Engineering & Technology, Lahore Pakistan Class rank = 2/260.
Thesis Title: Design and analysis of DWDM systems.

AWARDS AND HONORS:

- 2008-2009 Mentor SURF Purdue University (<https://engineering.purdue.edu/Engr/Research/SURF/>)
2008 Mentor Electrical & Computer Engineering Department, Purdue University, USA
2007 Purdue University Graduate Tuition Award
2006-2009 Mentor Fulbright Students Purdue University, USA
2005-2009 Fulbright USA Fellowship (www.iie.org)
2004-2005 Resident Tutor, Iqbal Hall, University of Engineering & Technology, Lahore Pakistan
2002 K.E. Durrani Award for first position in Electrical Engineering Department, University of Engineering & Technology, Lahore Pakistan (www.uet.edu.pk)
2001-2002 Class Representative and Proctor, Electrical Engineering Department, University of Engineering & Technology, Lahore Pakistan
1997-1998 Merit Scholarship from Government of Pakistan
1995-1996 Merit Scholarship from Government of Pakistan

TEACHING EXPERIENCE:

- 2005** **Assistant Professor** (Study leave)
Electrical & Computer Engineering Department,
University of Engineering & Technology, Lahore Pakistan
- 2003-2005** **Lecturer**
Electrical & Computer Engineering Department,
University of Engineering & Technology, Lahore Pakistan

RESEARCH SUMMARY:

My research activities focus mainly in the field of theoretical and computational Nano-electronic with particular efforts in finding ways to get around technological challenges and explaining experiments. I work on computation of electronic structure including all essential physical effects: long range atomistic strain, piezoelectricity, coulomb and exchange interactions etc. A number of quantum dot based devices have been investigated as a potential candidate for next-generation optics and quantum information processing. My research heavily depends on the theory of condensed matter physics, and makes the use of novel numerical algorithms and state-of-the-art large-scale high-performance cluster computing for multi-million atomic simulations. I am also an active member of

Network for Computational Nanotechnology, developing Nano-electronic software packages for researchers and academicians around the globe.

PUBLICATIONS:

Journal Paper:

- [5] Muhammad Usman*, Hoon Ryu*, and Gerhard Klimeck, "-----", under preparation (to be submitted to PRB)
- [4] Muhammad Usman*, Matthias Tan*, Hoon Ryu, and Gerhard Klimeck, "----", under preparation (to be submitted to PRB/IEEE TNANO)
- [3] Shaikh Ahmed*, Neerav Kharche*, Rajib Rahman*, **Muhammad Usman***, Sunhee Lee, Hoon Ryu, Hansang Bae, Steve Clark, Benjamin Haley, Maxim Naumov, Faisal Saied, Marek Korkusinski, Rick Kennel, Michael McLennan, Timothy B. Boykin, and Gerhard Klimeck, "Multimillion Atom Simulations with NEMO 3-D", Springer Encyclopedia for Complexity, Editor-in-chief: Meyers, Robert A, ISBN: 978-0-387-75888-6, June 2009, pg. 5745-5783 (arXiv:0901.1890v1 [physics.comp-ph]) (*Equal contribution)
- [2] **Muhammad Usman**, Hoon Ryu, Insoo Woo, David S. Ebert, and Gerhard Klimeck, "Moving towards nano-TCAD through multi-million atom quantum dot simulations matching experimental data", IEEE Trans. on Nanotechnology, Vol. 8, No. 3, May 2009, pp. 330-344 (also at <http://arxiv.org/abs/0812.3814>)
- [1] Gerhard Klimeck, Shaikh Ahmed, Neerav Kharche, Marek Korkusinski, **Muhammad Usman**, Marta Prada, and Timothy B. Boykin, "Atomistic Simulation of Realistically Sized Nanodevices Using NEMO 3-D: Part II - Applications", (INVITED) Special Issue on Nanoelectronic Device Modeling in IEEE Transactions on Electron Devices, Vol. 54, Issue 9, Sept. 2007 Page(s):2090 - 2099 (2007)

Invited Talks:

- [4] Gerhard Klimeck, Mathieu Luisier, Rajib Rahman, **Muhammad Usman**, Neerav Kharche, Hoon Ryu, Sunhee Lee, and Dragica Vasileska, "NEMO 3-D and OMEN: Nanoelectronic modeling tools for advanced semiconductor device studies and their deployment on nanoHUB.org", American Chemical Society meeting, Salt Lake City, Utah, 22-26 March 2009
- [3] **Muhammad usman**, "Strain and electronic structure calculations in realistically scaled InAs/GaAs quantum dot systems", 1st NCN Student Research Symposium, Purdue University, June 2008
- [2] Gerhard Klimeck, Neerav Kharche, **Muhammad Usman**, Timothy B. Boykin, "Multi-Million Atom Simulations of Strain and Electronic Structure with NEMO 3-D", Materials Science and Technology Conference and Exhibition (MS&T), Pittsburgh, October 5-9, 2008
- [1] Gerhard Klimeck, Shaikh Ahmed, Clemens Heitzinger, Neerav Kharche, **Muhammad Usman**, Mathieu Luisier, Raseong Kim, Neophytos Neophytou, Michael McLennan, and Timothy B. Boykin, "Quantum Dot, Nanowire, and Bandstructure Modeling and Deployment on nanoHUB.org", International Topical Workshop "Tera- and Nano-Devices: Physics and Modeling", University of Aizu, Aizu-Wakamatsu, Japan in October 16-19, 2006

Conference Proceedings and Presentations (APS, MRS, IEEE NANO, IWCE, ICPS)

- [15] **Muhammad Usman**, and Gerhard Klimeck, "Wavelength tuned InAs quantum dots", Submitted to American Physical Society, March Meeting Portland Oregon, 2010
- [14] **Muhammad Usman**, Hoon Ryu, Sunhee Lee, Yui M. Tan, and Gerhard Klimeck, "Quantum Confined Stark Effect in Biased InAs/GaAs Quantum Dots", 13th International Workshop on Computational Electronics (IWCE), Tsinghua University, Beijing, May 27-29 2009 (Oral Presentation) DOI:10.1109/IWCE.2009.5091140
- [13] **Muhammad Usman** and Gerhard Klimeck, "Quantum confined stark effect in non-identical InAs/GaAs coupled quantum dots: Dependence on vertical electrical field", American Physical Society, March Meeting, Pittsburgh, March 16-20, 2009 (Oral Presentation)
- [12] Gerhard Klimeck, Mathieu Luisier, **Muhammad Usman**, Neerav Kharche, Hoon Ryu, Sunhee Lee, Dragica Vasileska, "Nano-Scale Carrier Transport on an atomistic basis using NEMO 3-D and OMEN", Aspen Winter Conference on Unifying Themes in Condensed Matter, Jan. 12-16, 2009 (Oral Presentation)

- [11] **Muhammad Usman**, Hoon Ryu, Shaikh Ahmed, and Gerhard Klimeck, "Atomistic tight binding study of interband light transitions in self-assembled InAs/GaAs quantum dots", Material Research Society, Fall 2008 Meeting Boston, December 1-4, 2008 (Oral Presentation)
- [10] Gerhard Klimeck, Mathieu Luisier, **Muhammad Usman**, Neerav Kharche, Hoon Ryu, Sunhee Lee, Dragica Vasileska, "Nanoelectronic Modeling using NEMO 3-D and OMEN and their Deployment on nanoHUB.org", 13th Advanced Heterostructures and Nanostructures Workshop, Hapuna Beach, Hawaii, Dec. 7-12, 2008
- [9] **Muhammad Usman**, Dragica Vasileska, and Gerhard Klimeck, "Strain-engineered self-organized InAs/GaAs quantum dots for long wavelength applications", Proceedings of ICPS 2008 (International Conference on the Physics of Semiconductors), Rio de Janeiro, Brazil, July 27-Aug 1, 2008 (Poster Presentation).
- [8] **Muhammad Usman**, Shaikh Ahmed, and Gerhard Klimeck, "A tight binding study of strain-reduced confinement potentials in identical and non-identical InAs/GaAs vertically stacked quantum dots", IEEE nano 2008, Arlington, TX, August 18-21, 2008 (Oral presentation) (8th IEEE Conference on Nanotechnology, 2008, NANO '08, August 18-21 2008 Page(s):541-544
- [7] **Muhammad Usman**, Shaikh Ahmed and Gerhard Klimeck, "Strain and Piezoelectric effect on electronic structure of vertically stacked InAs/GaAs Quantum dots", American Physical Society, March Meeting, March 2008 New Orleans (Oral Presentation)
- [6] Shaikh Ahmed, **Muhammad Usman**, Neerav Kharche, Andrei Schliwa, and Gerhard Klimeck, "Atomistic Simulation of Non-Degeneracy and Optical Polarization Anisotropy in Pyramidal Quantum Dots", IEEE International Conference on Nano/Micro Engineered and Molecular Systems (IEEE-NEMS), Jan 16-19, 2007, Bangkok Thailand (Oral presentation) (340 submissions, 55% oral presentations)
- [5] Shaikh Ahmed, **Muhammad Usman**, Clemens Heitzinger, Rajib Rahman, Andrei Schliwa, and Gerhard Klimeck, "Symmetry Breaking and Fine Structure Splitting in Self-Assembled Zincblende Quantum Dots: Atomistic Simulations of Long-Range Strain and Piezoelectric Field", proceedings of the 28th International Conference on the Physics of Semiconductors, ICPS 2006, Vienna, Austria, July 24-28 2006, AIP Conference Proceedings Volume 893, pg 849 (Poster presentation).
- [4] **Muhammad Usman**, Shaikh Ahmed, Marek Korkusinski, Clemens Heitzinger, and Gerhard Klimeck, "Strain and electronic structure interactions in realistically scaled quantum dot s tacks", proceedings of the 28th International Conference on the Physics of Semiconductors, ICPS 2006, Vienna, Austria, July 24-28 2006, AIP Conference Proceedings Volume 893, pg. 847 (Poster presentation).
- [3] Gerhard Klimeck, Shaikh Ahmed, Clemens Heitzinger, Neerav Kharche, **Muhammad Usman**, Mathieu Luisier, Raseong Kim, Neophytos Neophytou, Michael McLennan, and Timothy B. Boykin, "Quantum Dot, Nanowire, Bandstructure Modeling and Deployment on nanoHUB.org", International Topical Workshop "Tera- and Nano-Devices: Physics and Modeling", University of Aizu, Aizu-Wakamatsu, Japan in October 16-19, 2006 (Oral presentation)
- [2] Sebastien Goasguen, Jon Camden, **Muhammad Usman**, Steven Clark, Jaime Frey, Clemens Heitzinger, and Gerhard Klimeck, "nanoHUB - nanoscience gateway to the TeraGrid", TeraGrid 2006, Indianapolis, IN June 12-15, 2006.
- [1] **Muhammad Usman** and Noor M. Sheikh, "Performance analysis of adaptive source rate control (ASRC) algorithm for VoIP", TENCON 2005, IEEE region 10 conference Melbourne Australia Nov. 2005 Page(s):1 – 7 (poster presentation) (Oral presentation)

PROFESSIONAL SERVICES

- 2008 Reviewer, Phys. Rev. B Journal
- 2008 Reviewer, Journal of Condensed Matter Physics

PROFESSIONAL AFFILIATIONS

- Student Member, Institute of Electrical and Electronics Engineers (IEEE)
- Student Member, American Physical Society (APS)
- Student Member, Material Research Society (MRS)
- Member, Network for Computational Nanotechnology, Purdue University (<https://www.nanohub.org>)

REFERENCES:

1. **Prof. Dr. Gerhard Klimeck** (gekco@purdue.edu)
Electrical & Computer Engineering Department, Purdue University USA
2. **Prof. Dr. Sheikh Ahmad** (ahmed@siu.edu)
Electrical and Computer Engineering Department, Southern Illinois University, Carbondale, IL, USA
3. **Prof. Dr. Noor M. Sheikh** (adstec@lycos.com)
Electrical & Computer Engineering Department, UET Lahore Pakistan
4. **Prof. Dr. Hasan Raza** (hraza@engineering.uiowa.edu)
Electrical & Computer Engineering Department, University of IOWA, IOWA USA

COMPUTER SKILLS:

1. **JAVA, C++, and C** Experience of programming with **MPI, OpenMP, and pthread**
2. **Keil and Assembly languages** of INTEL and MIPS architectures.
3. **Verilog/VHDL** hardware description language, Xilinx FPGA boards for the synthesis of digital circuits.
4. **MATLAB** Engineering Toolboxes.
5. **Pajek** Software.
6. Office Utility software like MS word, MS Excel, MS power point etc