

AKSHAY KUMAR RATHORE

PhD (Power Electronics), M.S. (Electrical Machines and Drives), B.E. (Electrical Engineering)

E-mail: akshay@uvic.ca; rathore@uni-wuppertal.de

PH: +49-202-4391217; +49-202-4391736;

Fax: +49-202-4391824

Home page: www.ece.uvic.ca/~akshay

PRESENT STATUS

Postdoctoral Research Fellow, Electrical Machines and Drives Research Lab, Wuppertal University, Wuppertal (North-Rhine Westphalia), Germany.

INTERESTS

Soft-switching Techniques for High-frequency Power Conversion, DC-DC converters, Resonant Converters, Inverters for Distributed Generation and Renewable Energy Sources (Fuel cells, Solar), Grid-connected Inverters, Dynamics and Control of Switch Mode Power Supplies, Control of Induction Motor Drives. Pulse-width modulation (PWM) Techniques, Optimization, Variable Frequency Control of AC Motor Drives, Linear Induction Motor.

EDUCATION

Ph. D.: **University of Victoria, BC, Canada.** September 2004 - August 2008.

Power Electronics; 2008, CGPA = 8.8/9.0.

Thesis topic: High-Frequency Transformer Isolated Soft-Switched Converters for Fuel Cell to Utility Interface

M. Tech.: **Institute of Technology, Banaras Hindu University (IT-BHU), Varanasi, India.**

Electrical Machines and Drives; 2003; CGPA = 8.75/10. Aug. 2001-Jan 2003.

Gold Medal for highest academic standing.

Dissertation: Modeling, Simulation and Analysis of Linear Induction Motor Drive

Minor Project: Development of Linear Induction Motor Equivalent Circuit Model and Performance Analysis Incorporating Eddy Current and Exit Edge Losses

**The project and dissertation thesis contributed towards modeling the linear induction motor in d-q reference frame and development of equivalent circuit model incorporating end and edge effects. Using the derived dynamic modeling of linear induction motor, decoupled control of attraction force and propulsion force (thrust) was presented using MATLAB/SIMULINK. Performance analysis was done for traction load. Also, the mathematical expression for attraction force between the primary and secondary members was derived.*

B. E.: **Maharana Pratap University of Agriculture and Technology, Udaipur, India.**

Electrical Engineering; Aug. 1997-July 2001; First Class.

Project: Design and Testing of C-Band Satellite TV Receiver

Ph. D. THESIS WORK

The motivation of this thesis was to design and develop a soft-switched inverter system for fuel cell to utility interface application. This research presents interfacing of fuel cells to a single-phase utility line using high-frequency transformer isolated power converters. It contributes towards selecting, analyzing and designing high-frequency transformer isolated soft-switched power converters for fuel cells to utility interface application to achieve high efficiency, compact size, low cost inverters and would benefit in commercializing the fuel cells for energy systems.

AWARDS

- Marquis “**Who’s Who in the World**”, Listed in October 2008 Edition.
- Marquis “**Who’s Who in America**”, Listed in November 2008 Edition.
- Marquis “**Who’s Who in Science and Engineering**”, Listed in September 2006 Edition.
- Awarded “Thouvenelle Graduate Scholarship” by University of Victoria, 2006-2007.
- Awarded “University of Victoria Full Fellowship (Ph D Level)” for 2004-2005.
- Awarded Student Travel Grant from IEEE Industrial Electronics Society for IEEE International Symposium on Industrial Electronics (ISIE) 2004 held in France.
- Awarded Student Travel Grant from IEEE Industrial Electronics Society for IEEE International Conference on Industrial Technology (ICIT) 2003 held at University of Maribor, Slovenia.
- Awarded **GOLD MEDAL** for standing first in M. Tech. (Electrical Engineering) in 2003.
- Awarded Certificate of Merit in M. V. Chauhan National Level Paper Presentation Contest 2001, organized by IEEE India Council for paper entitled ‘Equivalent Circuit Modelling of Linear Induction Motor with End Effect and Skin Effect Compensation’.
- Awarded scholarship by Ministry of Human Resource and Development (MHRD) and University Grants Commission (UGC) for M. Tech. (Electrical Engineering) program 2001-2003.
- Qualified in Graduate Aptitude Test in Engineering (GATE)-2001 with 93.75 percentile in Electrical Engineering.
- Awarded Certificate of Merit by Ministry of Human Resource and Development, India for Secondary (10th) Examination 1994 and Higher Secondary (12th) Examination 1996.

TEACHING EXPERIENCE

- Sessional Lecturer in Department of Electrical and Computer Engineering, University of Victoria, Victoria, BC, Canada. May 2007 – December 2007
 - Courses taught: 1) Power Electronics (ELEC 410)
2) Applied Electronics and Electrical Machines (ELEC 365)
 - Supervised two undergraduate projects, one group was awarded 3rd prize by IEEE Victoria branch.
- Lecturer in Electrical Engineering, Faculty of Engineering, Mody Institute of Technology and Science (Deemed University), Lakshmanagarh (Sikar), India. July 2003-August 2004.
 - Courses taught: 1) Industrial Electronics 2) Digital Electronics
3) Electronics Measurements and Instrumentation
 - Labs instructed: 1) Industrial Electronics Lab 2) Electrical Engineering Workshop
3) Electronics Measurements and Instrumentation Lab
4) Electronics Lab-II 5) DSP Lab (MATLAB programming part)
 - Seminar in-charge of undergraduate industrial training and project seminars
 - Supervised undergraduate projects
- Lecturer in Electrical Engineering, Maharana Pratap University of Agriculture and Technology, Udaipur, India. Feb. –July 2003.
 - Seminar in-charge of undergraduate industrial training and project seminars
 - Supervised undergraduate projects
 - Prepared syllabus for M. E. program in Power Electronics and Power Systems
 - Revised lab experiments for B.E. program

- Lab Instructor and Tutor in Department of Electrical and Computer Engineering University of Victoria, Victoria, BC, Canada. September 2007 – August 2008
- Labs instructed:
 - 1) Electrical Engineering Fundamentals (ELEC 199)
 - 2) Electronic Devices: I (ELEC 320)
 - 3) Electromechanical Energy Conversion (ELEC 370)
 - 4) Power Electronics (ELEC 410)
- Tutorial classes:
 - 1) Applied Electronics and Electrical Machines (ELEC 365)

RESEARCH EXPERIENCE

- Research Assistant in Power Electronics Research Lab, Department of Electrical and Computer Engineering, University of Victoria, Canada. Sept. 2004 - Aug. 2008.
-The research experience in power electronics research lab includes design and testing of power converters (DC-DC and DC-AC). I have designed, developed and tested successfully the voltage and current-fed zero-voltage switched (ZVS) converters of low and high power for fuel cell applications, operating at switching frequency of 100 kHz. The open loop control was programmed on FPGA. Closed loop control has been designed, built and tested using analog ICs. It also includes verification of design and simulation using power electronic softwares like PSIM, ICAPS (Intusoft), MATLAB etc.
- Research Fellow in Electrical Machines and Drives Research Lab, Wuppertal University, Germany. Sept. 2008 - till.
-The present research is towards generating optimal pulse pattern (switching angles) for five-level inverter to control medium voltage high power induction motor drive at low switching frequency (maximum switching frequency = 200 Hz). This result in low THD and low switching losses of devices and thus better utilization and high voltage output of the inverter. Optimization work is being done using Genetic Algorithms for lowest possible computation time (few days only) using MATLAB. The computation time for such problems using normal optimization is few months. It is a variable frequency induction motor drive, an industrial research project sponsored by WEG, Brazil.

REVIEWER

- IEEE Transactions on Power Electronics (PEL)
- IEEE Transactions on Industrial Electronics (IES)
- IEEE Transactions on Industry Applications (IAS)
- IET Journals Renewable Power Generation
- International Journal on Electrical Power and Energy Systems
- Journal of Electrical Power Components and Systems
- International Conferences sponsored by IEEE Industrial Electronics, ECCE, APEC etc.

INDUSTRIAL TRAINING

- Zinc Smelter, Hindustan Zinc Limited, Udaipur (Rajasthan), India for 30 days.
- Jyoti Limited, Vadodara (Gujrat), India for 45 days.

MEMBERSHIP OF PROFESSIONAL SOCIETIES

- Student Member of IEEE (USA)
- Student Member of IEEE Industrial Electronics Society (USA)

PUBLICATIONS

Journal:

1. A. K. Rathore, A. K. S. Bhat and Ramesh Oruganti, "A Comparison of Soft Switched DC-DC Converters for Fuel Cell to Utility Interface Application," *IEEJ Transactions on Industry Applications*, Vol. 128, No. 4, pp. 450-458.
2. A. K. Rathore, A. K. S. Bhat and Ramesh Oruganti, "Classification and Comparison of Interfacing Schemes for Connecting Fuel Cells to a Single-Phase Utility Line", Appearing soon in *IEEE Transactions on Industrial Electronics*.
3. A. K. Rathore, A. K. S. Bhat, S. Nandi and Ramesh Oruganti, "Closed Loop Control Design of Two-Inductor Current-fed Isolated DC-DC Converter for Fuel Cells to Utility Interface Application", Revision Submitted in *IET Journal on Power Electronics*.
4. A. K. Rathore, A. K. S. Bhat and Ramesh Oruganti "Wide Range ZVS Active-Clamped L-L Type Current-Fed DC-DC Converter for Fuel Cell to Utility Interface Application," Submitted to *IEEE Transactions on Power Electronics*.
5. A. K. Rathore, J. Holtz and T. Boller, "Synchronous Optimal Pulsewidth Modulation for Low Switching Frequency Control of Medium Voltage Multi-Level Inverters," Submitted to *IEEE Transactions on Industrial Electronics*.
6. A. K. Rathore, A. K. S. Bhat and Ramesh Oruganti "Small Signal Analysis and Closed Loop Control Design of L-L Type Active-Clamped ZVS Current-Fed Isolated DC-DC Converter," Submitted to *IET Journal on Renewable Power Generation*.

Conference:

7. A. K. Rathore and S. N. Mahendra, "Modelling and Simulation of Linear Induction Motor Transients Using MATLAB/SIMULINK," *International Conference on Electrical Engineering (ICEE)*, Hong Kong, 2003, 6 pages, CD ROM.
8. A. K. Rathore and S. N. Mahendra, "Decoupled Control of Attraction Force and Propulsion Force in Linear Induction Motor Drive," *IEEE International Conference on Industrial Technology (ICIT)*, Slovenia, 2003, pp. 524-529.
9. A. K. Rathore and S. N. Mahendra, "Simulation of Secondary Flux Oriented Control of Linear Induction Motor Considering Attraction Force and Transverse Edge Effect," *IEEE International Power Electronics Congress (CIEP)*, Mexico, October 2004, pp. 158-163.
10. A. K. Rathore, "Improved Performance of Fuzzy Logic Based Direct Field Oriented Controlled Induction Motor," *IEEE International Power Electronics Congress (CIEP)*, Mexico, October 2004, pp. 152-157.
11. A. K. Rathore and S. N. Mahendra, "Direct Secondary Flux Oriented Control of Linear Induction Motor," *IEEE International Conference on Industrial Technology (ICIT)*, India 2006, pp. 1586-1590.
12. A. K. Rathore, A. K. S. Bhat and Ramesh Oruganti, "A Comparison of Soft Switched DC-DC Converters for Fuel Cell to Utility Interface Application," *IEEE Power Conversion Conference (PCC)*, Nagoya, Japan, April 2007, pp. 588-594.
13. A. K. Rathore, A. K. S. Bhat and Ramesh Oruganti, "Analysis and Design of Active-Clamped ZVS Current-Fed DC-DC Converter for Fuel Cell to Utility Interface Application," *IEEE International Conference on Industrial and Information Systems (ICIIS)*, Sri Lanka, August 2007, pp. 503-508.
14. A. K. Rathore, A. K. S. Bhat, S. Nandi and Ramesh Oruganti "Closed Loop Control Design of Two-Inductor Current-fed Isolated DC-DC Converter for Fuel Cells to Utility Interface Application," *IEEE Industry Applications Society Annual Meeting (IAS)*, Edmonton, Canada, 2008.

15. A. K. Rathore, A. K. S. Bhat and Ramesh Oruganti "Small Signal Analysis and Closed Loop Control Design of L-L Type Active-Clamped ZVS Current-Fed Isolated DC-DC Converter," *IEEE Canadian Conference on Electrical and Computer Engineering (CCECE)*, Newfoundland and Labrador, Canada, May 2009.
16. A. K. Rathore and A. K. S. Bhat, "Comparison and Selection of Interfacing Schemes for Fuel Cells to a Single-Phase Utility Line" International Conference on Energy Engineering (ICEE), CD, Pondicherry, India, Jan. 2009, 7 proc. Pages, CD ROM.
17. A. K. Rathore, A. K. S. Bhat and Ramesh Oruganti "Wide Range ZVS Active-Clamped L-L Type Current-Fed DC-DC Converter for Fuel Cell to Utility Interface Application," *IEEE Energy Conversion Congress and Exposition (ECCE)*, USA, 2009.

INVITED SESSION PAPERS AND PRESENTATION

- "MATLAB Based Analysis of Linear Induction Motor Based Traction System", Short Term Course on LIM Based Metro, organized by Indian Railway Institute of Electrical Engineering (IRIEEN), Nasik, India, 2003.
- "ZVS Turn-on Soft- Switched DC-DC Converters for High Voltage Applications," *Graduate Innovation Forum*, Faculty of Engineering, University of Victoria, Victoria, BC, Canada, 2006.
- "High-Frequency Transformer Isolated DC-DC Converters for Fuel-Cell to Utility Interface", *India International Conference on Power Electronics (IICPE)*, Madras, 2006.
- "Comparison of Soft-switched DC-DC Converters and Design & Control of Wide Range ZVS DC-DC Converter", ABB Corporate Research, Baden, Switzerland, 18 June 2009.
- "Optimal PWM Control of Medium Voltage Drives using Multi-Level Inverters at Low Switching Frequency", General Electric Research, Bangalore, India, 2 July 2009.

EXTRA CURRICULAR ACTIVITIES

- State player of volley-ball (school level).
- Vice President of Engineering Student Association at College of Technology and Engineering (Maharana Pratap University of Agriculture and Technology), Udaipur, India in 1999-2000.
- Student Convener of Entrepreneurship Awareness Camp in 2000.
- Convener of Inter-College and Intra-College cultural and literary events; 1999-2001.
- Chairman of Electrical Engineering Society at College of Technology and Engineering, Maharana Pratap University of Agriculture and Technology, Udaipur, India, 2000-2001.
- Active Student Member of IEEE (USA) and IEE (UK) student Branch, IT-BHU Chapter, Varanasi, India in 2001-2002.
- Committee member in Graduate Innovation Forum, Faculty of Engineering, University of Victoria, Victoria, BC, Canada, 2006.
- Volunteered in *IEEE International Pacific Rim Conference*, Victoria, BC, Canada, 2007.
- Volunteered and judgment committee member in 'Design Engineering Challenge', University of Victoria, Victoria, BC, Canada, 2007.

SOFTWARE PROGRAMMING SKILLS

- VHDL Programming for FPGA
- C Language
- MathCad
- MATLAB software programming and SIMULINK
- Power Electronics simulation softwares i.e. PSpice Schematics, PSIM, ICAPS, Spice.

REFERENCES

1. **Dr. A. K. S. Bhat**, *Fellow IEEE*
Professor
Department of Electrical and Computer Engineering
University of Victoria, Canada.
Email: bhat@engr.uvic.ca

2. **Dr. Joachim Holtz**, *Fellow IEEE*
Professor Emeritus
Wuppertal University, Germany.
Email: j.holtz@ieee.org

3. **Dr. Subhasis Nandi**
Associate Professor
Department of Electrical and Computer Engineering
University of Victoria, Canada.
snandi@ece.uvic.ca

4. **Dr. S. N. Mahendra**, *Fellow IEE*
Professor and Head
Department of Electrical Engineering
Institute of Technology, Banaras Hindu University (IT-BHU)
Varanasi, India.
Email: mahendra20@gmail.com

5. **Dr. Henry Chung**
Professor and Dean
Department of Electronic Engineering
City University of Hong Kong, Hong Kong.
Email: eeshc@cityu.edu.hk