Muhammad Zohaib Iqbal

Personal Information

Address :	National University of Computer & Emerging Sciences
	A.K. Brohi Road, H-11/4, Islamabad, Pakistan
Date of Birth:	August 14, 1982
Email:	zohaib.iqbal@nu.edu.pk
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Expertise

Model-driven Engineering of Software Systems

Automated Software Testing, Model-based Testing

Empirical Software Engineering

Software Development using Java EE, Java SE, and C/C++

Education

Doctor of Philosophy (Software Engineering) **(2009 – 2012)**

- Thesis Title: Environment Model-based System Testing of Real-time Embedded Software
- Supervisors: Prof. Lionel Briand, Dr. Andrea Arcuri
- Department of Informatics, University of Oslo, Norway

Master of Sciences (Major in Computer Science) **(2004 – 2006)**

- CGPA of 3.92 out of 4.0 *(Very High Distinction)*
- Thesis Title: Improving Coverage Criteria for State Collaboration Testing Model
- Supervisor: Prof. Jaffar-ur Rehman (late)
- Department of Computer Science, Mohammad Ali Jinnah University, Islamabad, Pakistan

Bachelor of Science (Major in Computer Science) **(2000 – 2004)**

- CGPA of 3.9 out of 4.0 *(Very High Distinction)*
- Department of Computer Science, Mohammad Ali Jinnah University, Islamabad, Pakistan

OMG Certified UML Professional – Fundamental (2009)

Experience

December 2012 – To date

Assistant Professor, National University of Computer & Emerging Sciences, FAS-NU, Islamabad, Pakistan

June 2012 – December 2012

Postdoctoral Research Fellow, Simula Research Laboratory, Oslo, Norway

Worked in the Certus Software V& V Center on model-based testing of real-time embedded software. My primary responsibilities included technology transfer of model-based testing techniques and tools to industry partners and developing new solutions for automated testing that meet the needs of industry partners.

June 2009 – May 2012

Research Fellow/PhD Student, Simula Research Laboratory, Oslo, Norway

Worked in the Certus Software V& V Center on a European ITEA-2 VERDE project (http://www.itea-verde.org/). The project focused on automated testing of real-time embedded software based on environment models developed using UML, MARTE, and OCL. The work was applied on two industrial case studies: for WesternGeco and Tomra in Norway. The testing strategies used were Adaptive Random Testing and Search-based Testing.

June 2009 – May 2012

Collaboration as part of PhD with WesternGeco AS and Tomra AS, Norway

Worked on automated testing of a complex real-time control system for marine seismic acquisition for WesternGeco and on automated testing of an automated bottle recycling system for Tomra. My responsibilities included understanding the domain of the systems, proposing a complete solution for automated system testing, software modeling, developing testing tool, and conducting workshops and tutorials.

July 2007 – June 2009

Lecturer, Department of Computer Science, Faculty of Basic & Applied Sciences, International Islamic University, Islamabad, Pakistan

Taught courses in the areas of Object-oriented Programming (C++, Java), Enterprise and Web Application Development (with Java EE), Design Patterns, and Software Quality Engineering (both graduate and undergraduate level). I also introduced two courses at graduate level: Model-driven Development and Model-based Software Testing. I also supervised a number of undergraduate projects and co-supervised MS theses.

July 2006 –July 2007

Lecturer, Department of Computer Science, Mohammad Ali Jinnah University, Islamabad, Pakistan

Taught courses in the area of Enterprise Systems Development (with Java EE), Object-oriented Analysis & Design (with UML), and Object-oriented Programming (with C++ and Java). I also supervised a number of undergraduate projects and co-supervised five MS theses. I was also selected as a moderator for a research group "Center for Software Dependability". The group had a number of graduate students working in the area of software testing and reliability.

October 2005 –June 2006

Software Engineer, Digital Processing Systems Inc. Islamabad, Pakistan

Participated in the analysis, design, and implementation of B2B and B2C software. The main contribution was in the J2EE based development of applications (Struts, JSP, Servlets, EJBs). I was also SCM representative of projects for the SCM-CMMI level-2 appraisal team.

January 2004 – December 2005

Teaching Assistant, Mohammad Ali Jinnah University, Islamabad, Pakistan

Assisted the teachers in conducting and evaluating lectures, labs, assignments, quizzes, and tests. Remained teaching assistant for the courses of Introduction to Object-oriented Paradigm, Object-oriented programming, Object-oriented Analysis & Design with UML, and Advanced Computer Programming with Java.

August 2003 – October 2005

Research Assistant, Mohammad Ali Jinnah University, Islamabad, Pakistan

As a research assistant, my activities included peer reviewing and writing research and term papers. As a member of Center of Software Dependability, I had a chance to work under the close guidance of Prof. Dr. Muhammad Jaffar-ur-Rehman. I was also involved in development of various research tools.

December 2002 – November 2003

Software Engineer, Universal Automation System, Islamabad, Pakistan

Developed a Project Management & Customer Support System (BOSS) that automates the administration of the projects of organization online customer support. The sub-modules included Project Management Module, Document Management Module, Customer Support Module and Bug Tracking Module. The project was developed using Servlets/JSP as Web interface, Session and Entity Enterprise Java beans to provide the business logic.

Research Activities

Selected Research Projects

- VERDE (2009 – 2012): The ITEA-2 VERDE project involves around 20 European partners (www.itea-verde.org) from Norway, France, and Germany. In Norway, the project is funded by Norwegian Research Council and involves six partners, including WesternGeco (www.slb.com) and Tomra AS (www.tomra.no), Norway who are our industry partners. The focus of the project is on providing model-based testing strategies for black-box system testing of real-time

embedded software. We have devised new fitness functions for such kind of testing and have evaluated the fault detection effectiveness of search-based testing and adaptive random testing.

- MOTER (2012 – to date): The project involves application of search-based algorithms for testing of model transformations. The project aims at identifying the effective meta-model and automated test data generation for model-transformation testing.
- AMOS (2010 – 2012): The project, funded by Norwegian Research Council, aimed at providing automated model-based testing techniques for state-based systems. My work was on the part of the project dealing with solving OCL constraints using artificial intelligence techniques. The work was being conducted in collaboration with Cisco System Inc, Norway (www.cisco.no).
- START (2006 – 2010): The project focused on automated selection of regression tests from a given test suite that was generated based on the UML state machines. The test cases were selected by identifying the changes at the diagram level and then by mapping them to the test suite. The project was completed in collaboration with Technische Universität Ilmenau, Ilmenau, Germany (www.tu-ilmenau.de) in 2010.
- DEXEM (2007 – 2008): The project was focused on testing of executable UML models based on data flow analysis. The analysis approach proposed was based on the action semantics at meta-model level and was independent of the syntax of the action language used in the models.
- WEBCOMP (2007 – 2009): The project involved testing of web-service composition modeled using UML profile for Business Process Execution Language (BPEL). The project was completed in collaboration with Abo Akademi University, Turku, Finland (www.abo.fi/public/en) in 2009.
- SCOTEM (2004 – 2006): The project focused on state-based integration testing of object-oriented software. The project was conducted in collaboration with Prof, Lionel Briand, who was then associated with Software Quality Engineering Lab (SQUALL) at Carleton University, Ottawa, Canada (http://squall.sce.carleton.ca).

International Journal Publications

1. Muhammad Zohaib Iqbal, Andrea Arcuri, and Lionel Briand, "A Practical Approach to Environment Modeling and Simulation for Testing of Real-time Embedded Software", *revision accepted for publication at Journal of Software and System Modeling (SoSyM), 2013, corresponding TR: http://simula.no/publications/Simula.simula.368*
2. Shaukat Ali, Muhammad Zohaib Iqbal, Andrea Arcuri, Lionel Briand, "Solving OCL Constraints for Test Data Generation in Industrial Systems with Search Techniques", *revision accepted for publication atIEEE Transaction on Software Engineering (TSE), 2012, corresponding TR: http://simula.no/publications/Simula.simula.14*
3. Andrea Arcuri, Muhammad Zohaib Iqbal, Lionel Briand, "Random Testing: Theoretical Results and Practical Implications", *in IEEE Transactions on Software Engineering (TSE), 2012, Vol. 38 (2), pp. 258 – 277* (impact factor: 3.04)
4. Shaukat Ali, Lionel C. Briand, M Jaffar-ur Rehman, Hajra Asghar, Muhammad Zohaib Iqbal, Aamer Nadeem, "A State-based Approach to Integration Testing for Object-Oriented Programs", *Information and Software Technology (Elsevier), 49(11-12), 2007* (impact factor: 1.39)

International Conference Publications

1. Muhammad Zohaib Iqbal, Shaukat Ali, Tao Yue, Lionel Briand, "Experiences of Applying UML/MARTE on Three Industrial Projects", *In: proceedings of IEEE/ACM International Conference on Model Driven Engineering Languages and Systems, Austria, vol. 7590/2012, pp. 642-658, LNCS, Springer – Verlag, Berlin Heidelberg, 2012.* **(Best paper award)**
2. Muhammad Zohaib Iqbal, Andrea Arcuri, Lionel Briand, "Combining Search-based Testing and Adaptive Random Testing to Improve Environment Model-based Testing of Real-time Embedded Systems", *In: proceedings of International Symposium on Search-based Software Engineering (SSBSE), Italy, volume 7515/2012, pp. 136-151, LNCS, Springer, Berlin Heidelberg, 2012* **(Best paper award)**
3. Muhammad Zohaib Iqbal, Andrea Arcuri, Lionel Briand, "Empirical Investigation of Search Algorithms for Environment Model-based Testing of Real-Time Embedded Software", *In: proceedings of ACM International Symposium on Software Testing and Analysis (ISSTA), USA, pp.*

199 – 209, 2012

4. Shaukat Ali, Muhammad Zohaib Iqbal, Andrea Arcuri, Lionel Briand, "A Search-based OCL Constraint Solver for Model-based Test Data Generation", *In: IEEE Proceedings of the 11th International Conference On Quality Software (QSIC 2011), Madrid, Spain, 2011*
5. Andrea Arcuri, Muhammad Zohaib Iqbal, Lionel Briand, "Black-box System Testing of Real-Time Embedded Systems Using Random and Search-based Testing", *In: IFIP International Conference on Testing Software and Systems (ICTSS), Lecture Notes in Computer Science (LNCS), Springer – Verlag, Berlin Heidelberg 2010*
6. Muhammad Zohaib Iqbal, Andrea Arcuri, Lionel Briand, "Environment Modeling with UML/MARTE to Support Black-Box System Testing for Real-Time Embedded Systems: Methodology and Industrial Case Studies", *In: ACM/IEEE International Conference on Model Driven Engineering Languages and Systems (MODELS), 2010, Lecture Notes in Computer Science (LNCS), Springer – Verlag, Berlin Heidelberg 2010*
7. Andrea Arcuri, Muhammad Zohaib Iqbal, Lionel Briand, "Formal Analysis of the Effectiveness and Predictability of Random Testing", *In: ACM International Symposium on Software Testing and Analysis (ISSTA), 2010* **(ACM SIGSOFT Distinguished Paper Award)**
8. Qurat-ul-an Farooq, Muhammad Zohaib Iqbal, Zafar Malik, Matthias Riebisch, "A Model-Based Regression Testing Approach for Evolving Software Systems with Flexible Tool Support", *In proceedings of 17th IEEE International Conference on Engineering of Computer-Based Systems (ECBS), pp. 41-49, ISBN: 978-0-7695-4005-4, May 2010, Oxford, UK*
9. Irum Rauf, Muhammad Zohaib Iqbal, Zafar Malik, "Model-Based Testing of Web Service Composition Using UML Profile", *In proceedings of 2nd Workshop on Model-based Testing in Practice, CTIT Workshop Proceedings Series WP09-08, pp 75 -84, ISSN 0929-0672, June 2009, Enschede, Netherlands*
10. Irum Rauf, Muhammad Zohaib Iqbal, Zafar Malik "UML based Modeling of Web Service Composition - A Survey", *in proceedings of IEEE 6th International Conference on Software Engineering Research, Management and Applications (SERA' 2008), August, 2008, Czech Republic, sera, pp.301-307*
11. Tabinda Waheed, Muhammad Zohaib Iqbal, Zafar I Malik, "Data Flow Analysis of UML Action Semantics for Executable Models", *In proceedings of 2008 European Conference on Model Driven Architecture Foundations and Applications (ECMDA) 2008, Lecture Notes in Computer Science (LNCS), Springer – Verlag, Berlin Heidelberg 2008. Volume 5098/2008, pp 79 – 93, 2008*
12. Atifah Ali, Aamer Nadeem, Muhammad Zohaib Iqbal, Mohammad Usman, "Regression Testing based on UML Design Models", *In proceedings of 13th IEEE Pacific Rim International Symposium on Dependable Computing(PRDC – 2007), Melbourne, Australia, December, 2007, ISBN: 0-7695-3054-0, doi: 10.1109/PRDC.2007.58*
13. Najla Raza, Aamer Nadeem, Muhammad Zohaib Iqbal, "An Automated Approach to System Testing Based on Scenarios and Operations Contracts", *In proceedings of Seventh International Conference on Quality Software (IEEE - QSIC, 2007), USA, October 2007, pages: 256-261, ISBN:978-0-7695-3035-2, doi: 10.1109/QSIC.2007.4385504*
14. Quratulann Farooq, Muhammad Zohaib Iqbal, Zafar I. Malik, Aamer Nadeem, "An Approach to Selective State-Machine based Regression Testing", *In proceedings of 3rd International Workshop on Advances in Model-based Testing (ACM AMOST, 2007), London, UK, 2007, pages: 44-52, ISBN:978-1-59593-850-3, doi :10.1145/1291535.1291540*

Papers under review

- Muhammad Zohaib Iqbal, Andrea Arcuri, Lionel Briand, "Automated System Testing of Real-Time Embedded Systems Based on Environment Models", *submitted to a journal, 2012, corresponding TR: http://simula.no/publications/Simula.simula.840*
- Tabinda Waheed, Muhammad Zohaib Iqbal , Zafar I Malik, Muhammad Uzair Khan, "Data Flow Analysis for Testing of Executable Models", *submitted to journal, 2013*
- Shaukat Ali, Muhammad Zohaib Iqbal, Andrea Arcuri, "Empirically Evaluating Improved Heuristics for Test Data Generation from OCL Constraints using Search Algorithms", submitted to conference, *2013, corresponding TR: http://simula.no/publications/Simula.simula.1546*

Citations

According to Google citations, I have over **240 citations** of my work in various international venues, with an **h-index of 9** (see: http://scholar.google.com/citations?user=sZFiVr4AAAAJ&hl=en). My research work has been cited in many top quality journals and conferences including, IEEE Transaction on Software Engineering (TSE), Information and Software Technology Journal (IST), and Software and Systems Modeling Journal (SoSyM).

Professional Services

Program Committee Member/Reviewer of Journals/Conferences

I am a reviewer for Software and Systems Modeling Journal (SoSyM) and Software Quality Journal (SQJ). I have also been a PC member for a number of conferences and workshops, including International Conference on Software Engineering Research, Management and Applications (SERA' 2009), International Conference on Quality Engineering in Software Technology (CONQUEST' 2009), and International Workshop on Model Based Testing (MOTES' 2008).

Consultancy

- *Consultant* for UNESCO for Technical Feasibility Analysis of Integrated Educational Management Information System (2008)

Honors and Awards

- Invited to participate at *Beihang Univeristy Academic Forum, 2012, China*. The university invited only a few international PhD students to give a talk at the forum after a strict selection process based on technical soundness of the PhD and publications in highly reputed journals/conferences.
- ACM SIGSOFT Distinguished Paper Award at International Symposium on Software Testing and Analysis (ISSTA) 2010 for the paper *Formal Analysis of the Effectiveness and Predictability of Random Testing* (http://www.sigsoft.org/awards/disPapAwd-rec.htm)
- Very High Distinction in Masters of Sciences (Computer Science) at Mohammad Ali Jinnah University, Islamabad, Pakistan
- Jinnah merit scholarship for the entire duration of Masters of Sciences (Computer Science) at Mohammad Ali Jinnah University, Islamabad, Pakistan
- Very High Distinction in Bachelor of Sciences (Computer Science) at Mohammad Ali Jinnah University, Islamabad, Pakistan

References

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