

# MUMIT KHAN

## RESEARCH AREAS

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- *Natural Language Processing*: Development of Natural Language Processing modules for Bangla; development of Bangla lexicon, morphological analyzer, spelling checker, optical character recognition software.
- *Nanolithography*: Physical model development of x-ray, electron and extreme ultraviolet lithographic processes, from source generation to pattern transfer.
- *Computational Sciences*: Computational methods in physics and engineering, wavefront engineering, multi-grid methods, optimization techniques for complex systems, computational geometry, visualization methods for large datasets, optical and x-ray optical ray tracing, solid geometry for CAD applications.
- *Parallel Algorithms*: Development of parallel algorithms, numerical in particular.
- *Software Engineering*: Development and application of software engineering methodologies to physical modeling and simulation, large software framework design, distributed and parallel processing, object-oriented design methodologies.

## PROFESSIONAL EXPERIENCE

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2008 – Present BRAC University Dhaka, Bangladesh  
*Professor, Computer Science and Engineering*  
*Head, Center for Research on Bangla Language Processing*

2006 – Present UW Center for Nano-Technology Madison, WI  
*Honorary Fellow*

2004 – 2008 BRAC University Dhaka, Bangladesh  
*Associate Professor, Computer Science and Engineering*

2003 – 2004 BRAC University Dhaka, Bangladesh  
*Assistant Professor, Computer Science and Engineering*

1995 – 2003 Center for Nano-Technology Madison, WI  
*Leader, Modeling and Simulation*

- Lead the development of physical models for nano- and bio-technology, software framework and architecture.  
<http://www.nanotech.wisc.edu/>
- Technology transfer to member companies - intellectual property as well as training of scientists and engineers.
- Supervise student and staff researchers, and manage computing facilities.

1991 – 1995 Center for X-ray Lithography Madison, WI  
*Member of the Research Staff*

- Develop and maintain **CXrL Toolset**, a suite of software tools to model, simulate and optimize x-ray lithography process.
- Design and develop **EXCON**, an object-oriented simulation framework for managing large experiments. **EXCON** provides a visual language for creating a network of

objects that attach to a *software bus* and communicate via *ports*; these objects are then distributed over a wide area network.

- Lead development of **SHADOW**, a de-facto standard x-ray optical design tool used by the Synchrotron Radiation community.
- Teach programming languages (C, C++, Tcl/Tk, Python, Java) and idioms.

## EDUCATION

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1998 – 2003 University of Wisconsin-Madison Madison, WI

*Ph.D. Software Engineering in Computational Sciences*

- Ph.D. Thesis title: *Virtual Lithography Laboratory: A Software Framework for Physics-Based Modeling and Simulation.*

1989 – 1991 University of Wisconsin-Madison Madison, WI

*M.S. Electrical and Computer Engineering*

- M.S. Thesis title: *Object-oriented Integration of Process Modeling Tools in X-ray Lithography.*

1985 – 1988 University of Wisconsin-Madison Madison, WI

*B.S. Electrical and Computer Engineering*

- Dean's Honor List – each semester
- Graduated with Distinction

## INVITED TALKS

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1. **Advances in Lithography for Nanostructures**, M. Khan, G. Han, and F. Cerrina, *Midwest Microscopy and Microanalysis Society Meeting, Madison, WI, October 2002.*
2. **Extendibility of proximity XRL: roadmap for 35 nm and beyond**, M. Khan and F. Cerrina, *MRS 2001 Fall Meeting, Boston, MA, November 2001.*
3. **SHADOW: Current Status**, M. Khan, S. Singh-Gasson, and F. Cerrina, *Synchrotron Radiation Instrumentation (invited poster), Stanford, CA, September 1999.*
4. **Advances in ray tracing of x-ray optical elements**, M. Khan, S. Singh-Gasson, and F. Cerrina, *SPIE Annual Meeting, Denver, CO, September 1999.*
5. **SHADOW: Design Tool for X-ray Optics**, M. Khan and F. Cerrina, *Workshop on Neutron Scattering Instrument Design, LBL, Berkeley, CA, September 1996.*
6. **XRL Modeling**, M. Khan, S. B. Bollepalli and F. Cerrina, *NTT, Atsugi, Japan, August 1996.*
7. **X-ray Lithography Process Modeling**, M. Khan and F. Cerrina, *Institute for System Research (invited seminar), University of Maryland, College Park, June 1996.*
8. **XRL Exposure Window Optimization Using CXrL Toolset**, M. Khan and F. Cerrina, *IEEE Lithography Simulation Workshop, Quebec City, Canada, September 1994.*
9. **Issues in Modeling Tool Integration**, M. Khan and F. Cerrina, *SEMATECH Litho WorkBench Review Meeting, Austin, Texas, March 1993.*
10. **SHADOW on UNIX**, M. Khan, C. Welnak and F. Cerrina, *European Synchrotron Research Facility, Grenoble, France, January 1991.*

## PUBLICATIONS

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1. **A High Performance Domain Specific OCR for Bangla Script**, Md. Abul Hasnat, S. M. Murtoza Habib and Mumit Khan, *Proc. ICS<sup>2</sup>E, (2007).*
2. **Isolated and Continuous Bangla Speech Recognition Implementation**,

- Performance and application perspective**, Md. Abul Hasnat, Jabir Mowla and Mumit Khan, *Proc. Statistical Natural Language Processing, Pattaya, Thailand, December, (2007)*.
3. **Building a Foundation of HPSG-based Treebank on Bangla Language for Probabilistic Analysis**, Altaf Mahmud and Mumit Khan, *Proc. 10<sup>th</sup> ICCIT, Dhaka, December, (2007)*.
  4. **A Light Weight Stemmer for Bengali and Its Use in Spelling Checker**, Md. Zahurul Islam, Md. Nizam Uddin and Mumit Khan, *Proc. 1<sup>st</sup> Intl. Conf. on Digital Comm. and Computer Applications (DCCA 2007), Irbid, Jordan, March 19-23, 2007*.
  5. **Segmentation free Bangla OCR using HMM: Training and Recognition**, Md Abul Hasnat, S M Murtoza Habib and Mumit Khan, *Proc. 1<sup>st</sup> Intl. Conf. on Digital Comm. and Computer Applications (DCCA 2007), Irbid, Jordan, March 19-23, 2007*.
  6. **Text To Speech for Bangla Language using Festival**, Firoj Alam and Mumit Khan, *Proc. 1<sup>st</sup> Intl. Conf. on Digital Comm. and Computer Applications (DCCA 2007), Irbid, Jordan, March 19-23, 2007*.
  7. **Error-tolerant Finite-state Recognizer and String Pattern Similarity Based Spell-Checker for Bengali**, M. Asadullah, M. Z. Islam, and M. Khan, *Proc. ICON 2007 (accepted for publication), (2007)*.
  8. **Extreme Ultraviolet Holographic Lithography: Initial Results**, Y. Cheng, A. Isoyan, J. Wallace, M. Khan, and F. Cerrina, *Applied Physics Letters*, **90**, 023116, (2007). [Peer reviewed]
  9. **Infrastructure for Bangla Information retrieval in the context of ICT for Development**, N. Haque, Md. H. Ali, M. Khan, and M. S. Abdullah, *Proc. ICS<sup>2</sup>E, (accepted for publication), (2006)*.
  10. **Comparison of different POS Tagging Techniques (n-gram, HMM and Brill's tagger) for Bangla**, F. Hasan, N. UzZaman, and M. Khan, *Proc. ICS<sup>2</sup>E, (accepted for publication), (2006)*.
  11. **JKimmo: A Multilingual Computational Morphology Framework for PC-KIMMO**, M. Z. Islam and M. Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006)*.
  12. **Bangla Text Input and Rendering Support for Short Message Service on Mobile Devices**, T. Rownok, M. Z. Islam, and M. Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006)*.
  13. **Minimally Segmenting High Performance Bangla OCR using Kohonen Network**, A. M. S. Shatil and M. Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006)*.
  14. **Skew correction of Bangla script using Radon Transform**, M. Habib, N. Noor and M. Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006)*.
  15. **N-gram based Statistical Grammar Checker for Bangla and English**, M. J. Alam, N. UzZaman, and M. Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006)*.
  16. **History (forward n-gram) or Future (backward n-gram)? Which model to consider for n-gram analysis in Bangla?**, N. Khan, M. T. Habib, M. J. Alam, R. Rahman, N. UzZaman, and M. Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006)*.
  17. **Rule based Automated Pronunciation Generator**, A. Mosaddeque, N. UzZaman, and M. Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006)*.
  18. **Analysis of n-gram based text categorization for Bangla in a newspaper corpus**, M. Mansur, N. UzZaman, and M. Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006)*.
  19. **Analysis and Observations From a Bangla news corpus**, Y. Arafat, Md. Z. Islam, N. UzZaman, and M. Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006)*.
  20. **Developing a Computational Grammar for Bengali using the HPSG Formalism**, N. Khan and M. Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006)*.
  21. **GIS Based Real Time Traveler Information System: An Efficient Approach to Minimize Travel Time Using Available Media**, A. Hasnat, M. M. Haque, and M.

- Khan, *Proc. 9<sup>th</sup> ICCIT, (accepted for publication), (2006).*
22. **A Comprehensive Bangla Spelling Checker**, N. UzZman and M. Khan, *Proc. Intl. Conference on Computer Processing of Bangla (ICCPB 2006), Dhaka, Bangladesh, February, (2006).*
  23. **A Complete English-to-Bangla Transliteration Scheme**, N. UzZman and M. Khan, *Proc. Intl. Conference on Computer Processing of Bangla (ICCPB 2006), Dhaka, Bangladesh, February, (2006)..*
  24. **Collaborative Lexicon Development for Bangla**, A. I. Sarkar, D. S. H. Pavel, and M. Khan, *Proc. Intl. Conference on Computer Processing of Bangla (ICCPB 2006), Dhaka, Bangladesh, February, (2006).*
  25. **A Proposed Automated Extraction Procedure of Bangla Text for Corpus Creation in Unicode**, D. S. H. Pavel, A. I. Sarkar, and M. Khan, *Proc. Intl. Conference on Computer Processing of Bangla (ICCPB 2006), Dhaka, Bangladesh, February, (2006).*
  26. **Teaching Compiler Development to Undergraduates Using a Template Based Approach**, Md. Zahurul Islam and M. Khan, *Proc. 8<sup>th</sup> ICCIT, Gazipur, Bangladesh, (2005).*
  27. **Morphological Analysis of Inflectional Compound Words in Bangl**, Sajib Dasgupta, Naira Khan, and M. Khan, *Proc 8<sup>th</sup> ICCIT, Gazipur, Bangladesh, (2005).*
  28. **T12: An Advanced Text Input System With Phonetic Support For Mobile Devices**, N. UzZaman and M. Khan, *Proc. IEE Mobility Conference 2005, Guangzhou, China, November, (2005).*
  29. **A Double Metaphone Encoding for Bangla and its Application to Spelling Checker**, N. UzZaman and M. Khan, *Proc. IEEE NLP-KE 2005, Wuban, China, October, (2005).*
  30. **Local Language Computing in Bangladesh: Status and Challenges**, M. Khan, *2<sup>nd</sup> International Joint Conference on Natural Language Processing (IJCNLP-05), Jeju Islan, Korea, October, (2005).*
  31. **A Double Metaphone Encoding for Approximate Name Searching and Matching in Bangla**, N. UzZaman and M. Khan, *Proc. 4<sup>th</sup> Intl IASTED Conf on Computational Intelligence, Calgary, Canada, July, (2005).*
  32. **Parsing Bangla with LFG: An Introduction**, M. N. Haque and M. Khan, *BRAC University Journal, Vol 2, No. 1, (2005).* [Peer reviewed]
  33. **Morphological Parsing of Bangla Words using PC-KIMMO**, S. Dasgupta and M. Khan, *Proc. 7<sup>th</sup> ICCIT, Dhaka, Bangladesh, (2004).*
  34. **Feature Unification for Morphological Parsing in Bangla**, S. Dasgupta and M. Khan, *Proc. 7<sup>th</sup> ICCIT, Dhaka, Bangladesh, (2004).*
  35. **A Bangla Phonetic Encoding for Better Spelling Suggestions**, N. UzZaman and M. Khan, *Proc. 7<sup>th</sup> ICCIT, Dhaka, Bangladesh, (2004).*
  36. **Modeling Clear Phase-Mask Materials for Sub-50 nm X-Ray Application**, D. Malueg, M. Khan, F. Cerrina, and J. W. Taylor, *Jpn. J. Appl. Phys., 43(6B), (2004).* [Peer reviewed]
  37. **Modeling for sub-50-nm x-ray application with phase masks**, J. W. Taylor, D. H. Malueg, F. Cerrina, M. Khan and D. Thielman, *Proc. SPIE, 5374, 311 (2004).*
  38. **Focusing X-Ray Microlenses**, M. Khan, D. Amy, M. Feldman, Q. Leonard, F. Cerrina, J. Murakowski and D. Prather, *J. Vac. Sci. Technol., in press (2003).* [Peer reviewed]
  39. **Stochastic modeling of high energy lithographies**, G. Han, M. Khan and F. Cerrina, *J. Vac. Sci. Technol., B 21(6), (2003).* [Peer reviewed]
  40. **A comment on a new ray-tracing program RIGTRACE for X-ray optical systems**, L. Alianelli, M. Sanchez del Rio, M. Khan and F. Cerrina, *[J. Synchrotron Rad. (2001), 8, 1047-1050], J. Synchrotron Rad., 10, 191 (2003).* [Peer reviewed]

41. **A Comprehensive Model of Electron Energy Deposition**, G. Han, M. Khan, Y. Fang, and F. Cerrina, *J. Vac. Sci. Technol., B* 20, (2002). [Peer reviewed]
42. **Can PXL print 35 nm? Yes.**, M. Khan, G. Han, G. Tsvid, T. Kitayama, J. Maldonado, and F. Cerrina, *J. Vac. Sci. Technol., B* 19(6), (2001). [Peer reviewed]
43. **Technique for 25 nm X-ray Nanolithography**, E. Toyota, T. Hori, M. Khan and F. Cerrina, *J. Vac. Sci. Technol., B* 19(6), (2001). [Peer reviewed]
44. **Focusing x-ray masks for printing very narrow features**, M. Feldman, M. Khan and F. Cerrina, *J. Vac. Sci. Technol., B* 19(6), (2001). [Peer reviewed]
45. **New results in high energy proximity x-ray lithography**, M. Khan, G. Han, J. Maldonado, and F. Cerrina, *Proc. SPIE*, 4343, 176 (2001).
46. **Processing latitude study on x-ray phase-shifting masks**, L. Yang, M. Khan, J. W. Taylor, Y. Vladimirovsky, and N. Dandekar, *Proc. SPIE*, 3997, 530 (2000).
47. **Image formation in EUV lithography: multilayer and resist properties**, F. Cerrina, S. Bollepalli, M. Khan, H. Solak, W. Li, and D. He, *Microelectronic Engineering*, 53, (2000). [Peer reviewed]
48. **Extension of x-ray lithography to 50 nm with a harder spectrum**, M. Khan, G. Han, S. B. Bollepalli, and F. Cerrina, *J. Vac. Sci. Technol., B* 17(6), (1999). [Peer reviewed]
49. **Pattern resolution of an x-ray beamline with a wide exposure field**, M. Khan, F. Cerrina, and E. Toyota, *J. Vac. Sci. Technol., B* 17(6), (1999). [Peer reviewed]
50. **Image formation in extreme ultraviolet lithography and numerical aperture effects**, S. B. Bollepalli, M. Khan, and F. Cerrina, *J. Vac. Sci. Technol., B* 17(6), (1999). [Peer reviewed]
51. **X-ray mask fabrication at CXrL**, Q. J. Leonard, J. Bansel, L. Yang, O. Vladimirovsky, B. S. Bollepalli, M. Khan, Y. Vladimirovsky, F. Cerrina, J. W. Taylor, K. Simon, L. C. Rathbun, and R. C. Tiberio, *Proc. SPIE*, 3676, 56 (1999).
52. **Imaging properties of the extreme ultraviolet mask**, S.B. Bollepalli, M. Khan, and F. Cerrina, *J. Vac. Sci. Technol., B* 16, (1998). [Peer reviewed]
53. **A Semi-Empirical Resist Dissolution Model For Sub-Micron Lithographies**, M. Khan, S.B. Bollepalli, and F. Cerrina, *Proc. MSM*, 1, 41 (1998).
54. **Modeling Image Formation In Layered Structures: Application to X-ray Lithography**, S. B. Bollepalli, M. Khan, and F. Cerrina, *Proc. MSM*, 1, 53 (1998).
55. **Parameter Extraction with Neural Networks**, L. Cazzanti, M. Khan, and F. Cerrina, *Proc. SPIE*, 3332, 654 (1998).
56. **Modeling Image Formation Using Point Sources**, S. B. Bollepalli, M. Khan, and F. Cerrina, *Proc. SPIE*, 3331, 388 (1998).
57. **Investigation of Mask Pattern Proximity Correction to Reduce Image Shortening in X-Ray Lithography**, Scott Hector, Victor Pol, Mumit Khan, Srinivas Bollepalli and Franco Cerrina, *Microelectronic Engineering*, 41-42, 271-274, (1998). [Peer reviewed]
58. **The Complete Modeling Of The Image Formation In X-ray Lithography**, S. B. Bollepalli, M. Khan, and F. Cerrina, *Proc. XEL* (1998).
59. **Revisiting Phase Shifting Masks in X-ray Lithography**, M. Khan, S. Bollepalli and F. Cerrina, *J. Vac. Sci. Technol., B* 15(6), Nov/Dec, 2255 (1997). [Peer reviewed]
60. **Automatic Mask Generation in X-ray Lithography**, S. Bollepalli, M. Khan and F. Cerrina, *J. Vac. Sci. Technol., B* 15(6), Nov/Dec 2238 (1997). [Peer reviewed]
61. **X-ray Lithography for  $\leq 100$  nm ground rules in complex patterns**, S. D. Hector, M. Khan, et al., *J. Vac. Sci. Technol., B* 15(6), Nov/Dec, 2517 (1997). [Peer reviewed]
62. **Topography Description Model for 3D exposure simulation**, M. Khan, S. Bollepalli and F. Cerrina, *Proc. SPIE*, 3051, 588 (1997).
63. **Evaluation of aerial image in XRL**, M. Yi, M. Khan, et al., *Proc. SPIE*, 3048, 126 (1997).

64. **X-ray phase-mask: Nanostructures**, Z. Chen, Q. Leonard, M. Khan and F. Cerrina, *Proc. SPIE*, 3048, 183 (1997).
65. **Simulation of x-ray mask defect printability**, B. S. Bollepalli, S. D. Hector, J. R. Maldonado, J. A. Leavey, F. Cerrina, and M. Khan, *Proc. SPIE*, 3048, 155 (1997).
66. **Extendibility of x-ray lithography to  $\leq 130$  nm ground rules in complex integrated circuit patterns**, S. D. Hector, M. Khan, et al., *J. Vac. Sci. Technol. B* 14(6), Nov/Dec (1996). [Peer reviewed]
67. **An Updated Model for X-ray Lithography**, M. Khan, L. Mohammad, L. Ocola, J. Xiao and F. Cerrina, *J. Vac. Sci. Technol. B* 6(12), Nov/Dec (1994). [Peer reviewed]
68. **Modeling and simulation of a positive chemically amplified photoresist for x-ray lithography**, A.A. Krasnoperova, M. Khan, S. Rhyner, J. W. Taylor, Y.Zhu, F. Cerrina, *J. Vac. Sci. Technol. B* 6(12), Nov/Dec (1994). [Peer reviewed]
69. **Modeling image formation: application to mask optimization**, J. Xiao, M. Khan, R. Nachman, J. Wallace, and F. Cerrina, *J. Vac. Sci. Technol. B* 12(6), Nov/Dec (1994). [Peer reviewed]
70. **Spectral Effects on X-ray Lithography**, W. Waldo, A. Krasnoperova, M. Khan, C. Capasso, J. W. Taylor, F. Cerrina, *Proc SPIE*, 2194, 129 (1994).
71. **Comparative study of x-ray lithography process optimization using theoretical and empirical tools**, W. Waldo, A. Krasnoperova, M. Khan, C. Capasso, J. W. Taylor, F. Cerrina, *Proc. SPIE*, 2194, 83 (1994).
72. **TRANSMIT: A beamline modeling program**, F. Cerrina, F. Baszler, S. Turner, and M. Khan, *Microelectronic Engineering*, 21, 103 (1993). [Peer reviewed]
73. **Image formation in x-ray lithography: process optimization**, F. Cerrina, J.Z.Y Guo, S. Turner, L. Ocola, M. Khan, and P. Anderson, *Microelectronic Engineering*, 17, 135 (1992). [Peer reviewed]
74. **Recent Developments in SHADOW**, C. Welnak, P. Anderson, M. Khan, S. Singh, and F. Cerrina, *Rev. Sci. Instrum.*, 63, 865-868 (1992). [Peer reviewed]
75. **X-ray dose density: a new radiation damage modeling tool**, F. Baszler, M. Khan, F. Cerrina, *Proc. SPIE*, 1671, 451 (1992).
76. **Effects of mirror surface roughness on exposure uniformity in synchrotron x-ray lithography**, G.M. Wells, R. Nachman, C. Welnak, S. Singh, J. Guo, M. Khan, S. Turner, F. Cerrina, Y. Vladimirovsky, and J. Maldonado, *J. Vac. Sci. Technol. B* 9, 3227-331 (1991). [Peer reviewed]
77. **EXCON: a graphics based experiment control manager**, M. Khan, P. Anderson, and F. Cerrina, *Proc. SPIE*, 1465, 315 (1991).
78. **Aerial image formation in synchrotron radiation-based x-ray lithography: the whole picture**, J.Z.Y. Guo, G. Chen, M. Khan, P. Anderson, and F. Cerrina, *J. Vac. Sci. Technol. B* 8, 1537 (1990). [Peer reviewed]

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#### LANGUAGES

Fluent in English, Bangla.

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#### REFERENCES

Available upon request.

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#### CONTACT INFORMATION

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