Resume of ***Dr. Tarun Kumar Sheel***

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Date of Birth: April 8, 1971

Nationality: Bangladeshi (by birth)

Marital Status: Married

Further and Higher Education

Name: PhD in Engineering
Subject and class of award: School of Science for Open and Environmental Systems
Awarding body: Keio University
Date of award: March 23, 2008
Name of institution attended: Graduate School of Science and Technology, Keio University
Dates attended: September 2003-March 2008

Name: M.Sc.(Thesis Group)
Subject and class of award: Applied Mathematics and First Class First (out of 120 students)
Awarding body: University of Dhaka
Date of award: August 21, 1997
Name of institution attended: Department of Mathematics, University of Dhaka
Dates attended: July 1992-June 1993 (Exam held in 1996, Thesis submitted in March 1997)

Name: B.Sc. (Honors)
Subject and class of award: Mathematics and First Class 15th (out of 100 students)
Awarding body: University of Dhaka
Date of award: January 18, 1995
Name of institution attended: Department of Mathematics, University of Dhaka
Dates attended: July 1989-June 1992 (Exam held in 1994)

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Work Experience

Employer	Title of position	Date of Joining	Full or Part-time	Job Duties
Universite Catholique de Louvain, Belgium	Postdoctoral Fellow	14/04/2009 – To Date	Full Time	Research in Scientific Computing using numerical methods.
Sylhet International University, Bangladesh	Associate Professor	01/10/2008-03/10/2009	Part Time	Taught Applied Mathematics in Computer Science Students
Shahjalal University of Sci. & Tech. (SUST), Sylhet, Bangladesh	Associate Professor	15/08/2008 – To Date	Full Time	Teaching and research in mathematics. Lectures delivered and supervise research students.
Kyushu University, Japan	Visiting Researcher	25/04/2008 – 30/09/2008	Part Time	Collaboration Research
Keio University, Japan	Visiting Assistant Professor	01/04/2008-27/04/2008	Part Time	Collaboration Research
SUST, Sylhet, Bangladesh	Assistant Professor	20/08/2001-14/08/2008	Full Time	Teaching and research in mathematics. Lecture delivered and supervise research student
SUST, Sylhet, Bangladesh	Lecturer	20/80/1998 – 19/08/2001	Full Time	Teaching and research in mathematics. Lecture delivered and supervise research student
Word Language Center, Japan	Assistant Teacher	12/2006 to 3/2008	Part Time	Taught Bangla Language
Kitsuki Elementary School, Japan	Assistant Teacher	11/2005 to 3/2008	Part Time	Taught English Language
Keio University, Japan	Research Assistant	11/2006 to 5/2007	Part Time	Web server Maintenance
Keio University, Japan	Research Assistant	10/2003 to 3/2005	Part Time	Research Project (Group)
Bangladesh International Tutorial, Bangladesh	Assistant Teacher	8/1997 to 1/1998	Part Time	Taught Mathematics and Science
London International School, Bangladesh	Assistant Teacher	8/1997 to 7/1998	Part Time	Taught Mathematics and Science

Teaching Activities

Undergraduate Level:

Basic Calculus with Analytical Geometry and its application, Hydrodynamics, Mechanics, Fortran Language, Ordinary and Partial Differential Equations, Mathematical Methods and Special Functions, Complex Variables, Linear Programming, Numerical Analysis I

Graduate Level:

Numerical Methods and Simulations Technique, Numerical Analysis II & III, Differential Equations II, Linear Algebra, Mathematical Methods and Special Functions, Fluid Mechanics with Applications, Mathematical Modeling and Simulation in Various Approaches, Computational Mathematics, Quantum Mechanics, Analytical Dynamics and so on.

Research Interest

Major interest:

Computational Fluid Dynamics with Turbulent Flow Analysis of Complex Geometry, Vortex Methods and Vortex Flows, Acceleration Techniques, Mathematical Modeling, Industrial Mathematics, Numerical Methods, Scientific Computing, High Performance Computing

Techniques, Parallel Computing with Distributed Memory (MPI, Open MPI, Open CL), Special-purpose Computers (MDGRAPE-2 and -3), Graphics Processing Units (GPU).

A. Past Research

1. Fast Vortex Method

A fast vortex method has been developed by using special-purpose computers those were exclusively designed for molecular dynamics simulations. A mathematical formulation for the 3D vortex method was developed for using the special-purpose computers MDGRAPE-2 for the 3D vortex method. Implementation of rigorous assessment of this hardware had been limited to a couple of problems. I made assessment of the performance of MDGRAPE-2 by comparing the performance of calculation with and without it. Consequently, acceleration of about 100 times was achieved by MDGRAPE-2 without loss of numerical accuracy. Then I turned to MDGRAPE-3, a successor of MDGRAPE-2, and, repeating the same calculations and developed fast vortex method. The simultaneous use of the **FMM** with MDGRAPE-2 and MDGRAPE-3 was devised to my previous calculations and further accelerations have been noticed. The various forms of the **FMM** and their performance on MDGRAPE-2 and MDGRAPE-3 were investigated.

2. Optimization

It has been observed that the definition of an optimum range of a function table plays an essential role to control and achieve satisfactory accuracy in MDRAPEs. An optimum range of a function table has been determined after a careful observation of computational domain of the collisions of a pair of vortex rings.

It has been clearly observed that the most time consuming parts of FMM calculations are multipole to local (M2L) translations for far field particles and the direct calculations of neighboring particles. The balance between these two steps is dependent on the level of box divisions. Hence an optimum level of box division has been determined according to the number of particles being calculated. In addition, an optimum level of box division has been determined when the FMM and pseudo-particle multipole method implemented on MDGRAPE-3.

3. Accelerations

The vortex method calculation is accelerated by the use of a special-purpose computer MDGRAPE-2. The calculation cost has been reduced by a factor of 100 when compared with the calculation of a conventional PC (Intel Pentium 4, 2.66GHz). This acceleration has been further improved when applied MDGRAPE-3 and the improvement in speed was 1000 times faster when compared with the host PC (Xeon 5160 3.00GHz) and 25 times faster compared with MDGRAPE-2. Further acceleration has been achieved with the simultaneous use of the FMM and MDGRAPE-3. The FMM on MDGRAPE-3 was about 16 times faster than MDGRAPE-3 itself, and approximately 4 times than that of FMM on a Xeon 5160 PC.

4. Accuracy

The global kinetic energy and enstrophy have been investigated to address the numerical accuracy. The results have good agreement when compared with the previous and referenced work. The results with and without the use of the FMM, MDGRAPE-2, MDGRAPE-3 and the combination of FMM & MDGRAPE-3 do not show any notable difference.

B. Present Research

1. Mesh Generation (GMSH)

Gmsh is an automatic three-dimensional finite element mesh generator with built-in pre- and post-processing facilities. Its design goal is to provide a simple meshing tool for academic problems with parametric input and advanced visualization capabilities. Gmsh is built around four modules: geometry, mesh, solver and post-processing. All geometrical, mesh, solver and

post-processing instructions are prescribed either interactively using the graphical user interface (GUI) or in text files using Gmsh's own scripting language. Interactive actions generate language bits in the input files, and vice versa. This makes it possible to automate all treatments, using loops, conditionals and external system calls.

2. Adaptive Mesh Generation

The problem of finite element mesh generation, especially for three dimensional regions, is a well known hard problem that has occupied the attention of many researchers for long time. Although significant progress has been made in devising its solution for certain classes of geometric domains, its solution for general domains is still an open issue. The need to generate finite element meshes quickly is a common requirement of most computational fields and it is an inherent requirement of any adaptive process. Therefore, the need for developing parallel mesh generation techniques is well justified. Several of the proposed parallel solution methodologies for finite element equations are based on the partitioning of the corresponding geometric data and their mapping to the target parallel architecture. Specifically, for message passing machines, the proposed parallel methodologies are based on some "optimal" decomposition of the associated finite element mesh.

3. Parallel Mesh Adaptation Library (MAdLib)

The problem of complex geometry will be solved by using high-order FEM with the help of MAdLib which has been introduced by J.-F. Remacle and Gaetan Compere of UCL, Belgium. At present I am working in this group to advent some new things to extended use of MAdLib for engineering problems. I will solve the problems with the use of high order Discontinuous Galerkin Method using this new software for Navier Stokes problems. The new algorithm will be applied to solve the complex geometry arise during land gearing of aircraft. Finally we will solve large-scale problems using high-performance computing technique such as cluster GPU provided by NVIDIA Tesla technology.

4. Parallel Calculation using clusters GPUs

The advent of multicore CPUs and manycore GPUs means that mainstream processor chips are now parallel systems. Furthermore, their parallelism continues to scale with Moore's law. The challenge is to develop application software that transparently scales its parallelism to leverage the increasing number of processor cores, much as 3D graphics applications transparently scale their parallelism to manycore GPUs with widely varying numbers of cores. CUDA is a parallel programming model and software environmenr designed to overcome this challenge while maintaining a low learning curve for programmers familiar with standard programming languages such as C.

We will do large scale calculation using this new technique to accelerate our complex body problems.

C. Future Research

1. Parallel computing using Open MP, Open CL with CUDA, PyCUDA, Parallel MAdLib with GPUs
2. Analysis of high-order, unstructured, finite-element methods
3. Development of associated efficient algorithms, including parallel computational techniques and advanced preconditioning methods for solving linear systems
4. Scientific computing applications for these methods of computational fluid dynamics in complex geometries
5. Simplification and introduction of these techniques to academic and industrial environments

Research Activities

Research grants held:

2009- : Postdoctoral Research Fellow, Universite Catholique de Louvain, Belgium
2007-2008: Graduate Students Research Grant, Faculty of Science and Technology, Keio University, Japan
2005-2008: KLL Doctor Students Grant, for doing research in PhD at Keio University
2007-2008: Amano Scholarship Foundation, Japan, for studying PhD at Keio University
2003-2006: Yoshida Scholarship Foundation, Japan, for studying PhD at Keio University
2000-2001: "Establishment of high-performance computing laboratory", Department of Mathematics, Shahajalal University of Science and Technology, Sylhet, Grants: Ministry of Science and Technology, The govt. of peoples republic of Bangladesh

Editorial and reviewing work:

Ongoing: Online Reviewer, International Journal of Engineering, Iran
Ongoing: Reviewer, Numerical Methods for Partial Differential Equations
Completed: Editor and Reviewer, 2nd International Conference organized by the Athens Institute for Education and Research (ATINER), Athens, Greece

Publications/on-going research papers

Research works

1. **T. K. Sheel,** Rational Approximants Generated by Pade Approximation and u-transform, M. Sc. Thesis, Department of Mathematics, University of Dhaka, 1997.

2. **T. K. Sheel**, Development of Vortex Methods for Fluid Flow Simulation in Environmental Problems, Proceedings: The 21st Century COE Program, System Design: Paradigm Shift from Intelligence to Life, Keio University, 2004:211-215

3. **T. K. Sheel**, Development of a Fast Vortex Method for Fluid Flow Simulation using Special-Purpose Computers, PhD Thesis, Keio University, March 2008.

Peer Reviewed Journals

1. **T. K. Sheel**, A. Halder, Application of Pade Approximation to problems of Fluid Dynamics; National Journal of SUST Studies, Sylhet, Bangladesh, Vol. 4, No. 1, pp. 26-33, 2002.

2. **T. K. Sheel**, K. Yasuoka, S. Obi, Fast vortex method calculation using a special-purpose computer; Computers and Fluids, Vol. 36, No. 8, pp. 1319-1326, 2007.

3. R. Yokota, **T. K. Sheel**, S. Obi, Calculation of isotropic turbulence using pure lagrangian vortex method, Journal of Computational Physics, Vol. 226, pp. 1589-1606, 2007.

4. **T. K. Sheel**, R. Yokota, K. Yasuoka, S. Obi, The study of colliding vortex rings using a special-purpose computer and FMM, Transactions of the Japan Society for Computational Engineering and Science, Vol. 2008, No. 20080003, 2008.

5. **T. K. Sheel**, A New Technique for the Calculation of Colliding Vortex Rings, International Journal of Engineering, Vol. 22, No. 2, pp. 205-12, 2009.

6. **T. K. Sheel**, Acceleration of Vortex Methods Calculation using MDGRAPE-2 and MDGRAPE-3: A Comparative Study, "Daffodil International University Journal of Science & Technology", Vol 4, No. 1, pp. 23-27, 2009.

7. **T. K. Sheel**, and S. Obi, High Performance Computing Techniques for vortex method calculations, International Journal of Theoretical and Computational Fluid Dynamics, DOI 10.1007/s00162-009-0149-y, 2009.

8. **T. K. Sheel**, Acceleration Techniques for Vortex Method Calculations: Part II, "SUST Studies", Sylhet, Bangladesh, to appear, 2009.

Paper in submission (Journal)

9. **T. K. Sheel**, Acceleration Techniques for Vortex Method Calculations: Part I, "SUST Studies", Sylhet, Bangladesh, Submitted.

10. **T. K. Sheel**, Formulation of a Fast Vortex Method for Vortical Flow Problems, "GANIT –A Journal of Bangladesh Mathematical Society", Bangladesh, Submitted.

11. **T. K. Sheel,** Acceleration of vortex method calculation using FMM and special-purpose computers, SIAM Journal on Scientific Computing, Submitted.

12. **T. K. Sheel,** Optimization and accuracy of fast multipole method for vortex method calculation, International Journal of Computational Methods, Submitted.

13. **T. K. Sheel,** Acceleration of bluff body calculation using MDGRAPE-2, International Journal of Engineering, Submitted.

14. **T. K. Sheel,** Introduction of vortex method to flow around bluff body, Journal of Computational Mathematics, Submitted.

Conference Proceedings

1. **T. K. Sheel**, A. Halder, On acceleration of convergence of series and its application to fluid dynamics; Proc. Mini-Workshop on applied mathematics, SUST, Sylhet, pp. 139-146, 1998.

2. **T. K. Sheel**, A. Halder, Rational approximants using the Pade approximants and the Levin u-transform : a comparative study; Proceeding: International Conference on Applied Mathematics & Mathematical Physics, SUST, Sylhet, pp. 13-20, 2000.

3. **T. K. Sheel**, K. Yasuoka, S. Obi, Acceleration of Vortex Method Calculation using MDGRAPE-2: A special-purpose computer; Proc. ICVFM2005, Yokohama, Japan, pp. 137-142, 2005.

4. **T. K. Sheel**, K. Yasuoka, S. Obi, Acceleration of vortex method calculation using a special-purpose computer and FMM; CD-ROM, ICCM2007, Hiroshima, Japan, April 4-6, 2007.

5. **T. K. Sheel**, A fast method for solving vortical flow problems, 8th APRU Doctoral Students Conference, CD-ROM, Keio University, Japan, July 30-Aug 3, 2007

6. **T. K. Sheel**, R. Yokota, K. Yasuoka, S. Obi, Calculation of the decay of colliding turbulent vortex rings; Proc. ICVFM2008, pp. 212-219, Daejeon, South Korea, April 21-23, 2008.

7. **T. K. Sheel**, High performance computing techniques for fluid flow simulation, 9th APRU Doctoral Students Conference, CD-ROM, Far Eastern National University, Vladevostok, Russia, July 14-18, 2008

Conference Presentations

1. J. Ghosh, **T. K. Sheel**, A. Halder, On stability of numerical solution of a system of differential equation: multisteps adaptive approach; Presented in Mathematical Conference, Chittagong University, 1999.

2. **T. K. Sheel**, High performance computing techniques for vortex method calculations, IUTAM Symposium, 150 Years of Vortex Dynamics, Copenhagen, Denmark, October 12-16, 2008.

3. **T. K. Sheel**, HPCA for Multidisciplinary Applications of Complex Fluid Flow, 10th USNCCM, Columbus, Ohio, USA, July 16-19, 2009.

Invited Talk

1. **T. K. Sheel**, Development of fast vortex methods for fluid flow simulations using special-purpose computers, Faculty of Mathematics, Kyushu University, Fukuoka, Japan, March 18, 2008.

2. **T. K. Sheel**, Fast vortex methods for fluid flow simulations, Courant Institute of Mathematical Sciences, New York University, New York, USA, July 22, 2009.

Administrative Experience

Administrative duties: Actively participated and worked as a core member of various committees in the Department and University (Exam committee, Director of computer lab, Student advisory committee and so on)

People management or supervision: Arranged three international conferences organized by the Department of Mathematics, Shahjalal University of Science and Technology, Bangladesh (In the years 1998, 2000, and 2002). In every event, around 50 international participants (USA, UK, Malaysia, India etc.) were attended. Also conducted regular seminar at the Department where the participants were from Mathematics and its related disciplines.

Budget or resource management: One of the core members of Department financial committee.

Project management: The research project: "Establishment of high-performance computing laboratory", Department of Mathematics, Shahajalal University of Science and Technology, Sylhet, Grants: Ministry of Science and Technology, The govt. of peoples republic of Bangladesh. This project has been successfully finished in the period July 2000 to June 2001.

Awards, Distinctions & Scholarships

2005-2008: KLL Doctor Students Grant, for doing research in PhD at Keio University
2007-2008: Amano Scholarship Foundation, Japan, for studying PhD at Keio University

2003-2006: Yoshida Scholarship Foundation, Japan, for studying PhD at Keio University
1997: Gold Medal from the Jagannath Hall, Dhaka University, for achieving the first position in M. Sc. (Thesis) final exam.
1996-1997: University scholarship for excellent result in M. Sc.(Thesis) final exam, Dhaka University, Dhaka, Bangladesh
1992-1993: University scholarship for excellent result in B. Sc.(Honors) final exam, Dhaka University, Dhaka, Bangladesh
1989-1992: Board stipend for excellent result in Higher Secondary Certificate exam, Rajshahi Board, Bangladesh
1986-1988: Board stipend for excellent result in Secondary School Certificate exam, Rajshahi Board, Bangladesh
1980: Primary scholarship in first grade in class five, Nagarkanda, Faridpur, Bangladesh

Extracurricular Activities

2003--To Date: Member, Swarolipi Cultural Academi, Tokyo, Japan
2003--To Date: Member, Universal Puja Committee, Japan
1991--To Date: Life Member, Swami Vibekananda Parishad, Bangladesh
1998--To Date: Member, Bangladesh Mathematical Society (BMS), SUST, Bangladesh
1997--To Date: Life Member, Bangladesh Mathematical Society (BMS), Bangladesh
1992--2000: Member and Director, Rotaract Club of Dhaka North, Rotary International District 3280, Bangladesh
1998--1999: President, Rotaract Club of Dhaka North, Rotary International District 3280, Bangladesh

Computer Literacy

Operating Systems: Windows, GNU/Linux, MDGRAPE-2/3
Languages: Fortran77/90, C/C++, Matlab7.1, Mathematica
Software: MS Word, Power Point, MS Excel, Latex, Emacs, and XOOPS
Graphics: Gnu plot, Adobe Illustrator CS, CD View, Adobe Photoshop

Language Proficiency

Bengali: Mother tongue
English: Good communicative and functional skills
Japanese: Successfully completed Minna no Nihongo I \& II

Competitive Test Score

TOEFL: Score 173 (2001)
IELTS: Overall Band 5.5 (2001)
GRE: Total Score 1440 (1998)

References

Dr. J.-F Remacle
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Relationship: PhD Thesis Supervisor

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Relationship: Former Colleague and Research collaborator

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Relationship: Senior Colleague

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Relationship: Research Collaborator