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Tomasz Koziara

Nationality: Polish

Employment

2016-present	Developer of open-source parmes.org software; Contractor at Rullion, UK.
2012-2015	Lecturer in Computational/Theoretical Solid Mechanics, Durham University, UK.
2009-2011	Postdoctoral Research Fellow, University of Glasgow, UK. EDF Energy funded fellowship on development of a High Performance Computing software, SOLFEC-1.0, for application to safety assessment of graphite nuclear plant cores.
2001-2004	Software developer, Robobat, Cracow, Poland. Developer of Finite Element Method software products for Civil Engineering.

Education

2004-2008	PhD in Computational Mechanics. Department of Civil Engineering, University of Glasgow. Thesis: "Aspects of Computational Contact Dynamics". The thesis received the ECCOMAS award as one of two best PhD theses of 2008 in Europe on computational methods in applied sciences and engineering.
1997-2002	Masters degree in Computational Mechanics. Department of Civil Engineering, Cracow University of Technology, Poland. Thesis: "XFEM modeling of cohesive fracture in concrete". Defended with distinction. Based on originally implemented computational software.

Current work

I work developing and supporting open-source parmes.org software in relation to its industrial application in the civil nuclear context in the UK. This work is funded by EDF Energy via a UK agency, Rullion. It is flexible in terms of time and location and has a part-time character.

Programming experience

I enjoy programming as a creative process and have a general interest in software development. I am open to learning new approaches and roles as practically required. Due to my background in Computational Mechanics, I worked on a variety of mesh-based algorithms, mostly in the context of the Finite Element Method (both 2D and 3D, linear and nonlinear). I worked implementing holistic solution frameworks in this context, including (non)linear dense/sparse algebra schemes, time stepping, and computational geometry. For dynamic contact simulations in SOLFEC-1.0, the geometrical aspect of such algorithms corresponded to contact detection, i.e. an efficient spatial search aimed at identifying pairs of interacting geometrical features. I implemented a variety of spatial search approaches (e.g. spatial hashing, segment-tree, kd-tree, octree, etc.) and classical computational geometry (e.g. Quickhull, GJK, etc.) and other classical algorithms and data structures (e.g. red-black trees, skip lists, memory pools, etc.). Many of these are available within the open-source SOLFEC-1.0 code (predominately written in C). I have used FORTRAN, C and C++ to implement numerical software, as well as Python, Scilab, MATLAB and some Julia, to prototype ideas across the past 20 years. I have experience of visualizing geometrical data using OpenGL (e.g. SOLFEC-1.0's viewer); using embedded Python as input interpreter; using FDH5 in conjunction with XML to output data in formats compliant with third party viewers (e.g. ParaView). I have a breadth of experience of applying MPI to achieve distributed memory parallelism (e.g. non-blocking implementations of non-linear Gauss-Seidel and Newton solvers in SOLFEC-1.0, as well as complex load balancing therein; one-sided MPI-3.0 Remote Direct Memory Access based communication in SOLFEC-2.0). I use an explicit Single Instruction Multiple Data (SIMD) programming approach (Single Program Multiple Data, SPMD), ISPC, to achieve high efficiency on modern compute cores (e.g. see PARMEC code and a prefix sort example distributed with ISPC), combined with various approaches for task-based parallelism (e.g. ISPC native, cpp-taskflow). The parmes.org portal documents some of the codes I worked on. See also: https://github.com/parmes and https://github.com/tkoziara. (Some experience with development of websites using Wordpress, or GitHub pages and Sphinx, Python, HTML, and JavaScrip can also be noted).

Research and development

I have been developing High Performance Computing (HPC) codes in the areas of multi-body and discrete element analysis. This includes development of various aspects of discretization and implicit time-stepping methods for multi-body frictional contact/impact problems, e.g. [1], [2] and [3]. I developed SOLFEC-1.0, a general implicit multi-body contact/impact simulation software [4], which provides context for current employment. Recent work on SOLFEC-2.0, a technological successor in this context, involves upgrades of modeling technology (e.g. contact resolution approach) and programming approaches (modern C++, MPI-3.0, SPMD/SIMD, tasks) in alignment with the evolution of the state of the art in the respective areas. See also: https://researchgate.net/profile/Tomasz_Koziara.

Academic experience

While at Durham I taught: Year 2 Static Systems: matrix methods for statics of 2d trusses and frames (a lecture course for 150+ students); Year 3 Civil Design: basics of concrete and steel design according to Eurocodes (a lecture course for 20-30 students of civil engineering); Year 4 Contact and Friction: basics of classical contact mechanics and aspects of numerical contact analysis (a lecture course for 75-100 students; developed from scratch); Supervised 4 to 7 final year students annually; Supervised one PhD student; Co-supervised one PhD student; Developed a year 2 experimental laboratory to accompany the Static Systems course; Supported other teaching activities: Year 1 CAD (basics of SolidWorks), Year 3 Civil CAD (basics of AutoCAD), Year 4 ABAQUS course (basics of nonlinear finite element analysis); Wrote and submitted two research proposals in collaboration with academics and industrial partners; Acted as a reviewer in International Journal for Numerical Methods in Engineering, Computer Methods in Applied Mechanics in Engineering; Presented at about 15 international conferences.

Invitations

I was invited to give a lecture on the HPC implementation of SOLFEC during a summer school on Nonsmooth Contact Mechanics (Aussois, France, Sep 2012, organized by Prof. Brogliato, INRIA, Grenloble); A visiting researcher at INRIA in Grenoble, France, summer 2011.

Awards

Zienkiewicz Prize for the best PhD thesis in 2008 in Computational Mechanics, awarded by the Association of Computational Mechanics in Engineering (ACME) in the UK; ECCOMAS award for one of two best PhD theses of 2008 in Europe on computational methods in applied sciences and engineering.

Note

This CV can be downloaded at https://parmes.org/_downloads/Tomasz-Koziara-CV.pdf in order to use embedded hyperlinks.

Selected publications

[1] T. Koziara, N. Bićanić. Semismooth Newton method for frictional contact between pseudo-rigid bodies. *Computer Methods in Applied Mechanics and Engineering* **2008**, *197*, 2763–2777.

[2] T. Koziara, N. Bićanić. Simple and efficient integration of rigid rotations suitable for constraint solvers. *Journal for Numerical Methods in Engineering* **2009**, *81*, 1073 – 1092.

[3] T. Koziara, S. Brasier, L. Kaczmarczyk. Co-rotated and reduced order finite element time integrators for multibody contact dynamics. *PARMES technical report TR1* **2017**.

[4] T. Koziara, N. Bićanić. A distributed memory parallel multibody Contact Dynamics code. *International Journal for Numerical Methods in Engineering* **2011**, *87*, 437–456.