Ali Karakuş

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Research Interests

Discontinuous/Continuous High-Order Finite Element Methods
Computational Fluid Dynamics, Multiphase and Incompressible Flows
High Performance Computing, CPU-GPU Parallelization
Polymer Flow Modeling in Manufacturing Processes

Education

Ph.D.,2009-2015, Middle East Technical University, Mechanical Engineering, Ankara, Turkey
M.S., 2006-2009, Mersin University, Mechanical Engineering, Mersin, Turkey
B.S., 2001-2005, Middle East Technical University Mechanical Engineering, Ankara, Turkey

Experience

Assistant Professor April 2020 to today
Mechanical Engineering Department, Middle East Technical University, Ankara, Turkey

Postdoctoral Researcher November 2018 to March, 2020
Mathematics and Computer Science, Argonne National Laboratory, Lemont, IL, USA

Postdoctoral Researcher November 2016 to November 2018
Applied Mathematics, Virginia Polytechnic and State University, Blacksburg, VA, USA

Senior Mechanical Design Engineer November 2015 to November 2016
Mechanical Design Department, Meteksan Defense Inc., Ankara, Turkey

Research Associate July 2013 to July 2014
Computational and Applied Mathematics, Rice University, Houston, TX, USA

Research Assistant July 2009 to September 2015
Mechanical Engineering, Middle East Technical University, Ankara, Turkey

Research Assistant November 2007 to August 2009
Mechanical Engineering, Mersin University, Mersin, Turkey

Research and Development Engineer May 2006 to November 2007
Driving System Division, TEMSA Automotive, Adana, Turkey

Publications

Journal Articles in Progress

1. **Karakus, A.**, Austin A.P. and Warburton T. "A GPU Accelerated Incompressible Flow Solver on Spherical Manifolds ", *Journal of Computational Physics*, to be submitted.

2. Austin, A.P., **Karakus, A.**, Chalmers, N. and Warburton T. "GPU-Accelerated Finite Element Elliptic Solvers Optimized for Spherical Shells ", *SIAM Journal of Scientific Computing*, to be submitted.

3. **Karakus, A.** and Warburton T. "High-order Computation of Distances to Implicitly Defined Surfaces: An Application to Level Set Reinitialization", *International Journal of Multiphase Flow*, to be submitted.

Submitted Articles & Preprints

1. **Karakus, A.**, Chalmers, N. and Warburton T. "GPU Accelerated Nodal Discontinuous Galerkin Methods for Incompressible Multiphase Flows: High-order Phase-Field Models.", *Journal of Computational Physics*, submitted.

Refereed Journal Publications

1. **Karakus, A.**, Chalmers, N., Hesthaven, J.S. and Warburton T., 2019 "Discontinuous Galerkin discretizations of the BoltzmannBGK equations for nearly incompressible flows: Semi-analytic time stepping and absorbing boundary layers.", *Journal of Computational Physics*, 390, pp:175-202.

2. **Karakus, A.**, Chalmers, N., Katarzyna S., and Warburton T., 2019 "A GPU Accelerated Discontinuous Galerkin Incompressible Flow Solver.", *Journal of Computational Physics*, 390, pp:380-404.

3. Katarzyna S., Chalmers N., **Karakus, A.**, and Warburton T., 2019 "Acceleration of Tensor-product Operations for High-Order Finite Element Methods. ", *International Journal of High Performance Computing Applications*, DOI:10.1177/1094342018816368.

4. **Karakus, A.**, Warburton T., Aksel H., and Sert, C., 2018 "An Adaptive Fully Discontinuous Galerking Level Set Method for Incompressible Multiphase Flows.", *International Journal of Numerical Methods for Heat and Fluid Flow*, 28(6), pp:1256-1278.

5. **Karakus, A.**, Warburton T., Aksel H., and Sert, C., 2016. "A GPU Accelerated Level Set Reinitialization for an Adaptive Discontinuous Galerkin Method.", *Computer & Mathematics with Applications*, 72(3), pp:755-767.

6. **Karakus, A.**, Warburton T., Aksel H., and Sert, C., 2016. "A GPU Accelerated Adaptive Discontinuous Galerkin Method for Level Set Equation.", *Journal of Computational Fluid Dynamics*, 30(1), pp:56-68.

7. Tutar, M. and **Karakus, A.**, 2014. "Numerical Study of Polymer Melt Flow in a Three Dimensional Sudden Expansion: Effect of Viscous Dissipation.", *Journal of Polymer Engineering*, 135(1), pp:1-16.

8. Tutar, M. and **Karakus, A.**, 2013. "Computational Modeling of the Effects of Viscous Dissipation on Polymer Melt Flow Behavior During Injection Molding Process in Plane Channels.", *Journal of Manufacturing Science and Engineering* (ASME) 135(1), pp:1-16.

9. Tutar, M. and **Karakus, A.**, 2013. "A Numerical Study of Solidification and Viscous Dissipation Effects on Polymer Melt Flow in Plane Channels.", *Journal of Polymer Engineering*, 33(1), pp:355-384.

10. Tutar, M. and **Karakus, A.**, 2010. "Computational Study of the Effect of Governing Parameters on a Polymer Injection Molding Process for Single-Cavity and Multicavity Mold Systems.", *Journal of Manufacturing Science and Engineering* (ASME), 132(1), pp:1-12.

11. Tutar, M. and **Karakus, A.**, 2009. "Injection Molding Simulation of a Compressible Polymer.", *Journal of Polymer Engineering*, 29(6), pp:355-384.

12. Tutar, M. and **Karakus, A.**, 2009. "3-D Computational Modeling of Process Condition Effects on Polymer Injection Molding.", *International Polymer Processing*, 2009(5), pp: 384-398.

Conference Proceedings & Presentations

1. **Karakus, A.**, Chalmers, N., and Warburton, T. "libParanumal: GPU Accelerated Scalable High-order Finite Element Flow Solvers", *SIAM Conference on Computational Science and Engineering*, February 25-March 1 2019, Spokane, Washington, USA

2. Warburton, T., Medina, D., and **Karakus, A.**, "OCCA: Open Concurrent Compute Abstraction", *SIAM Conference on Computational Science and Engineering*, February 27-March 3 2017, Atlanta, GA, USA

3. Oner, S.D., **Karakus, A.**, Cetin, B., and Baranoglu B., "Parallel Boundary Element Formulation for 2D Microfluidic Particulate Flow for Multi-threaded Architectures." *ECCOMAS Congress*, June 05-08 2016, Crete Island, Greece

4. **Karakus, A.**, Warburton T., Aksel H., and Sert, C., "An Adaptive Fully Discontinuous Galerking Level Set Method for Incompressible Free Surface Flows." *European Conference on Numerical Mathematics and Advanced Applications*, September 14-18 2015, Ankara, Turkey

5. Ongut, A. E., Aksel, M. H., Turan, R., **Karakus, A.**, Erkursun, B., Cicek, E., Demircioglu, O. and Kilkis, B.,A ,"Numerical Study For The Improvement of Automobile Cabin Confort Conditions Using External Cooling Units Operated by Phovoltaic Solar Panels.", *6th Automotive Technologies Congress*, June 4-5 2012, Bursa, Turkey

6. Tutar, M., and **Karakus, A.**, "3D Numerical Simulation of Polymer Injection Molding" *in Proc. of 6th ICCHMT-International Conference on Computational Heat and Mass Transfer*, May 18-21 2009, Guangzhou, China

7. Tutar, M., and **Karakus, A.**, "3D Computational Modeling of Effects of Geometric Conditions on Injection Molding" *International Materials Symposium*, October 15-18, 2008, Denizli, Turkey

8. Tutar, M., and **Karakus, A.**, "Computational Modeling of Three-dimensional Compressible Filling Process" *International Symposium on Advances in Computational Heat Transfer*, May 11-16, 2008, Marrakech, Morocco

Technical Reports

1. Kolev T., Fischer P., Abdelfattah A., Ananthan S., Barra V., Beams N., Bleile R., Brown J., Carson R., Camier J.S., Churchfield M., Dobrev V., Dongarra J., Dudouit Y., **Karakus A.**, Kerkemeier S., Medina D., Merzari E., Min M., Parker S., Ratnayaka T., Smith C., Sprague M., Stitt T., Thompson J., Tomboulides A., Tomov S., Tomov V., Vargas A., Warburton T., Weiss K., "ECP Milestone Report: Improve performance and capabilities of CEED-enabled ECP applications on Summit/Sierra, Milestone CEED-MS34", March, 2020

2. Tomov S., Abdelfattah A., Barra A., Beams N., Brown, J., Camier, J.S., Dongarra, J., Dudoit Y., Fischer P., **Karakus, A.**, Kerkemier S., Kolev T., Lan Y.H., Merzari E., Min, M., Obabko A., Parker S., Rathnayaka T., Thomspson J., Tomboulides A. Tomov V. and Warburton T., "ECP Milestone Report: Performance tuning of CEED software and 1st and 2nd wave apps, Milestone CEED-MS32", October, 2019

3. Camier, J.S., Fischer P., **Karakus, A.**, Kerkemier S., Lan Y.H., Medina D., Merzari E., Min, M., Obabko A., Rathnayaka T., Shaver D., Tomboulides A., Tomov V. and Warburton T., "ECP Milestone Report: Engage second wave ECP/CEED applications, Milestone CEED-MS23", December, 2018

4. Katarzyna S., Chalmers N., **Karakus, A.**, and Warburton T., "GPU Accelerated Spectral Element Operators for Elliptic Problems", Center of Efficient Exascale Discretizations (CEED), Quarter Report, October, 2017

Thesis

1. **Ph.D:** High-Order Discontinuous Galerkin Level Set Methods for Incompressible Multiphase Flows, METU, Mechanical Engineering, Supervisor: Prof. M. Haluk Aksel, Prof. Cuneyt Sert, 2015

2. **M.Sc:** A 3D Numerical Model for Injection Molding Simulation, MU, Mechanical Engineering, Supervisor: Prof. Mustafa Tutar, 2009

Projects

1. "Exascale Computing: PDE Based Simulations on Unstructured Grids", **Researcher**, Center of Efficient Exascale Discretizations (CEED), September, 2016 - today

2. "High-order Numerical Methods on Many-core and GPU-based Architectures for Interface Capturing in Incompressible Multiphase Flows", **Researcher**, Computational and Applied Mathematics, Rice University, Houston, TX , July, 2013-July, 2014.

3. "Design of an Unmanned Underwater Vehicle Operating Under High Speeds", ASELSAN, **Researcher**, September, 2009 - July, 2013.

4. "Automotive Solar Cooling: Research and Development and Prototype Manufacturing for Electronic-Thermal-Mechanical-Photovoltaic Systems", **Researcher**, Turkish Automobile Factories (TOFAS), Project No: METU-BLTR- T-2008-0804-C-20, September, 2012 - May, 2013.

5. "Development of a Two-dimensional Laminar Navier-Stokes Solver for Cartesian Grids", **Researcher**, Engineering Research Committee, The Scientific and Technical Research Council of Turkey, Project No: 109M510, August, 2011 - June, 2012.

6. "A Design Project of an Ideal Metal-Insert Leakproof Fitting Operating Under Very High Pressures", **Researcher**, Engineering Research Committee, The Scientific and Technical Research Council of Turkey, Project No: 106M465, September, 2007 - June, 2009.

7. "Producing Electrical Power from the Sea Environment", **Researcher**, Engineering Research Committee, Turkish Ministry of Industry and Trade, Project No: 00280.STZ.2008-1, June, 2008 - July, 2009.

Developed Solvers

1. **nekRS:** A Spectral Element Multiphysics Solver for Exascale Architectures. *Lead Developer* Argonne National Laboratory. (2018 - 2020)

2. **PARANUMAL:** A Multi-CPU/GPU High-order Continuous/Discontinuous Galerkin Parallel Multiphysics Solver for Exascale Computations, *Co-Developer*. *Lead Developer:* Tim Warburton, Virginia Tech. (2016 -)

3. **SMUDG:** A 2D/3D Discontinuous Finite Element Solver for Interface Capturing in Incompressible Flows for Platform Independent CPU-GPU Parallelization. *Lead Developer*. (2013 - 2016)

4. **SMUDGm:** An Easy to Track, High-Order Adaptive Discontinuous/Continuous Finite Element MATLAB environment for Testing New Numerical Algorithms. *Lead Developer*. (2012 - 2015)

5. **HELMm:** A 2D High-Order Hamilton-Jacobi Solver with Artificial Diffusion Stabilization and Fast Adaptive Contouring. *Lead Developer*. (2012 - 2013)

6. **hpCONT:** A 2D/3D High-Order Adaptive Contouring for Solving Reinitialization Problems and Visualization of High-Order Finite Elements. *Lead Developer*. (2014 - 2015)

Awards

Doctoral Research Fellowship (TUBITAK)	2013
Publication Awards (METU/TUBITAK)	2013 - 2016
Full Undergraduate Fellowship (TEV)	2001 - 2005

Programming and Software

Basic Programming:	C, C++, Fortran, MATLAB
Parallel Programming API's:	OCCA, OpenCL, CUDA, MPI, OpenMP
Analysis:	ANSYS,COMSOL
3D Design:	Catia, SolidWorks, CREO
Word Editing:	LaTeX, Office Applications

References

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