Kyle Beggs

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Education

Expected Dec 2023 — **University of Central Florida, College of Engineering and Computer Science**
PhD Mechanical Engineering (computational mechanics)
Thesis: "A Meshless Approach to Simulating Multiscale Hemodynamics Models"

Dec 2018 — **University of Central Florida, College of Engineering and Computer Science**
MS Mechanical Engineering (thermofluids)
Thesis: "Hemodynamic Optimization of the Fontan Surgery Using a Multiscale Computational Fluid Dynamics Fluid-Structure Interaction Model"

Dec 2016 — **University of Central Florida, College of Engineering and Computer Science**
BS Mechanical Engineering (thermofluids)
Thesis: "Design of a Physical Windkessel Model for Use in LVAD in-vitro Benchtop Modeling"

Experience

Nov 2022 - Current — *Orlando, FL*
Metalenz
Software Engineer (Computational Physics)

- Development of computational electromagnetics and optics software.
- Work closely with the research/analysis engineers in assessing their needs for the in-house suite of simulation software.
- Identify computational bottlnecks and ease them to help speed up product development.
- Leverage next-gen computational tools to further accelerate design-simulation workflow.

Jan 2020 - Current — *Orlando, FL*
Computational Mechanics Lab, University of Central Florida
Graduate Research Assistant (PhD)

- Developing a meshless PDE solver with a focus on multiscale models for use in hemodynamics simulations. This includes all phases of simulation: geometry import and node generation, discretization, boundary condition treatment, and linear system construction and solution.
- Developing the code base to make use of automatic differentiation for fast optimization procedures.

May 2020 - Current — *Orlando, FL*
Centecorp Technological
Computational Analysis Engineer - Contractor (part-time)

- Computational analysis of a multiscale (from microns to meters) domain modeling radiation, conduction, and conjugate heat transfer at cryogenic temperatures.
- Used STAR-CCM+ for the full analysis (meshing, solving, post-processing) and SolidWorks for geometry/CAD creation.

Jan 2019 - Jan 2020 — *Boston, MA*
Dassault Systèmes SIMULIA, Physics R&D Department
Machine Learning Engineer (6 months full-time internship, 6 months part-time contractor)

- Developing a tool for doctors to use for Cardiovascular Disease (CVD) diagnostics.
- Tuning established Convolutional Neural Network (CNN) models in Python for medical image segmentation.
- Implemented eigenvalue-based filters to output all 'vessel-like' objects in the medical image volume as preprocessor to CNN. Performed custom data-augmentation.
- Aided in developing GUI with the Visualization Toolkit (VTK) for manually segmenting medical images to be used for training the CNN.

Jan 2016 - Dec 2018
Orlando, FL

Computational Mechanics Lab, University of Central Florida
Graduate Research Assistant (MS)

- Developed a multiscale 0D-3D Computational Fluid Dynamics (CFD) Fluid-Structure Interaction (FSI) model to verify a new cardiovascular surgical procedure attempting to alleviate a congenital heart defect.
- Employed STAR-CCM+ to mesh, compute, and post-process. Modified an in-house C++ code to interface with STAR-CCM+ using Java macros to provide real-time (dynamic) boundary conditions.
- Mentored new students in the lab. Liaison to the HPC cluster maintainers. Managed experimental lab equipment and software. Wrote scripts to automate tasks for other students to speed up workflow.

Skills

Computational Science and Engineering

- Scientific code development writing well-documented and clean code.
- Knowledge in algorithms for optimization, interpolation, regression, solution of ODEs and PDEs, and reduced-order modeling techniques.
- High Performance Computing (HPC) using distributed or shared memory parallelism. Scripting in Shell and Python.

Languages: Julia, Python, C++, C, MATLAB, CUDA. Developing in *nix-like environments.

Libraries / APIs: PyTorch, MPI, Eigen.

Commercial Software: Paraview, STAR-CCM+, Abaqus Standard/Explicit, SolidWorks, 3-matic.

Experimental Tools: 3D-printing, rheometer, data acquisition system setup, machining (mill, lathe, etc.)

Relevant Courses (Graduate)

Computational: Computational Fluid Dynamics, Finite Elements, Numerical Methods, Optimization in Engineering, Computational Biofluids
Mechanics: Continuum Mechanics, Fluid Mechanics, Heat Transfer
Computer Science: Deep Learning for Medical Imaging, C programming
Biomedical: Biofluid Mechanics, Bioinstrumentation, Anatomy

Teaching

Spring 2021 – 2022
Orlando, FL

Department of Mechanical and Aerospace Engineering, University of Central Florida
Computer Laboratory Instructor, Graduate Course 'Computational Biofluids'

- Taught the laboratory section of a graduate course in computational biofluid mechanics where I first covered the basics of CFD and transitioned to methods for recreating physiologically-accurate hemodynamics using STAR-CCM+.
- Topics covered included the full pipeline of a CFD simulation: geometry preparation/importing surface mesh, volume meshing, physics model selection/considerations, dynamic boundary conditions based upon external user code, and post-processing.

Aug 2015 - Current
Orlando, FL

Department of Mechanical and Aerospace Engineering, University of Central Florida
Computer Laboratory Instructor, Undergraduate Course 'Numerical Methods for Engineers'

- Teach the laboratory section of an introductory course on numerical methods in engineering. Focus on translating theory from lecture to working code to solve engineering problem.
- Topics include: roots of equations, large linear systems of equations via direct and iterative methods, interpolation and curve fitting, ODEs.

Academic Extracurriculars

Sep 2021 - Current

Journal of Open Source Software
Reviewer

Aug 2015 - Aug 2016

Biomedical Engineering Society (BMES), University of Central Florida
Research Affairs Chair

Jul 2014 - Dec 2016

National Science Foundation COMPASS Program, University of Central Florida
Mentor

Selected Publications

Journal Articles

1. **Beggs, K.**, Kassab A., Divo E. (2023) "A meshless multiscale method for simulating hemodynamics." Engineering Analysis with Boundary Elements, 150, 167-179. https://doi.org/10.1016/j.enganabound.2023.01.032
2. Giannuzzi, L., Colletta, M., Yu, Y., Kourkoutis, L., Iams, A., **Beggs, K.**, & Kassab, A. (2022). "Cryo-EXLO for Cryo-TEM of FIB Specimens." Microscopy and Microanalysis, 28(S1), 1244-1244. https://doi:10.1017/S1431927622005153
3. Eslahpazir, B. A., **Beggs, K.W.**, & Le, T.Q. (2018). "A Lumped-Parameter Computational Model Shows Mild Inflow Disease Does Not Require Hybrid Revascularization During Placement of the Femorofemoral Bypass." Annals of Vascular Surgery, 52, 12. doi: https://doi.org/10.1016/j.avsg.2018.07.022

4. Eslahpazir, B. A., **Beggs, K. W.**, Lauters, Z. M., Kassab, A. J., & Decampli, W. M. (2017). "Translating In-Vitro And Computational Multi-Scale Models For The Vascular Surgeon." Annals of Vascular Surgery, 38, 7-8. doi:10.1016/j.avsg.2016.10.021

Conference Presenations

1. **Beggs, K.**, Kassab A., Divo E. (2022) "A Localized Radial-Basis Function Meshless Method for Simulating Multiscale Hemodynamics Models." 45th International Conference on Boundary Elements and other Mesh Reduction Methods, Online.
2. Giannuzzi, L., Colletta, M., Yu, Y., Kourkoutis, L., Iams, A., **Beggs, K.**, & Kassab, A. (2022) "Novel Use of EXLO for Cryo-Manipulation of FIB Specimens." Microscopy and Microanalysis Conference, Portland, Oregon.
3. **Beggs, K. W.**, Ni, M. W., Prather, R. O., Divo, E., Kassab, A. J., DeCampli, W. M. (2018, October) "Investigation of an Injection Jet Shunt for the Fontan Surgery Using a Tightly-Coupled Multiscale Computational Fluid Dynamics Model." 2018 Biomedical Engineering Society (BMES) Annual Meeting, Atlanta, Georgia.
4. Ni, M., Prather, R., **Beggs, K.**, Rodriguez, G., Quinn, R., Divo, E., Fogel, M., Kassab, A., DeCampli, W. "Computational Investigation of Patient-Specific Self-Powered Fontan Circulations." ASFTE Digital Library. 3rd Thermal and Fluids Engineering Conference (TFEC), Fort Lauderdale, FL, USA.
5. **Beggs, K. W.**, Ni, M. W., Prather, R. O., Divo, E., Kassab, A. J., DeCampli, W. M. (2018, July) "Multiscale Computational Fluid-Structure Interaction Investigation of an Injection Jet Shunt for the Fontan Procedure." 8^{th} World Congress of Biomechanics, Dublin, Ireland.