Reza Sadeghi, PhD Candidate, Mechanical Engineer

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Work Experience

Research assistant 2017- present

(I) Developing non-invasive computational-mechanics and imaging-based diagnostic framework for personalized cardiology for coarctation of aorta disease:

- Using FVM-based solver (OpenFoam) and LBM-based solver (OpenLB) to model turbulent and transitional flow in large arteries.
- Using Smagorinsky LES family models to model blood flow.
- Performing advanced medical imaging codes and techniques to segment and reconstruct CT and MRI Images.
- Integrate CFD solver with 4D Flow magnetic resonance imaging MATLAB tool.
- Verifying the computational tool with Taylor-Green vortex and turbulent cavity flow CFD benchmarks.
- Comparing and validating the computational tool with available personalized 4D flow data, Echocardiography data, Catheter pressure drop data and particle image velocimetry data (PIV)

(II) Integrate 4D flow MRI imaging techniques and lattice Boltzmann method:

- Worked in collaboration with Libin Cardiovascular Institute of Alberta team to investigate computational framework using advanced 4D MR flow imaging and CFD techniques.
- Carried out comprehensive statistical analysis using MATLAB and Python on 4D MRI-measured aorta data and compared against numerical simulation data.

(III) Collaborate in developing an innovative non-invasive Doppler-based patient-specific lumped-parameter algorithm and a 3-D strongly coupled fluid-solid interaction (FSI-OPENFOAM-extend) framework to model transcatheter aortic valve replacement.

CFD engineer/designer assistant 2015- 2017

- Design, optimize and CFD Analysis of a shell and tube heat exchanger.
- Review and evaluate design specifications of heat exchanger.
- Generation of computational meshes and performing Conjugate heat transfer CFD analyses using ANSYS- CFX was performed to improve the heat transfer and baffle numbers, location and shapes optimized.
- Report and communicate results to team.

Research assistant 2012- 2015

- Developed a parallel LBM solver for compressible flow C++, Fortran and MATLAB.
- Developed a parallel multiphase flow model (with and without heat transfer) for high density ratio using C++, Fortran and MATLAB.
- Writing UDF for ANSYS-Fluent in C language for simulation of boiling heat transfer.

Software Skills

- **Programming Languages:** C++, Python, Fortran, MATLAB and Bash
- **Libraries:** OpenMP, TensorFlow, Keras, Numpy, Pandas, Scikit-learn, Scipy, Seabron, SQL, OpenCV, Matplotlib.
- **Simulation/meshing/postprocessing software:** Ansys (CFX), Ansys (Fluent), OPENFOAM, ANSYS (Mechanical), ABAQUS, OPENLN, Palabos, ICEM CFD, SALOME, Gmsh, PARAVIEW, Tecplot
- **CAD software:** SOLIDWORKS, AUTODESK (INVENTOR), Fusion360, Meshmixer, Freecad
- **Medical Imaging packages:** ITK-SNAP, OsiriX

Some of the Courses attended

- Advanced fluid mechanics
- CFD (finite volume method)
- Computational Aerodynamics
- Special Topics in Thermo-Fluid Sciences -Advanced Computational Fluid Dynamics
- Turbulence
- CFD (finite difference method)
- Advanced pumps
- Computational Modeling of Circulatory System
- Multiphase flow
- Advanced heat transfer
- Advanced numerical methods
- Machine learning (deep learning, neural network)

EDUCATION

PhD: Mechanical engineering 2017- present

McMaster University, Hamilton, Canada
Advisor: Dr. Zahra Keshavarz Motamed
Dissertation: Computational framework for coarctation of aorta

MSc: Mechanical engineering 2012-2015

University of Tehran, Tehran, Iran
Advisor: Dr. Mohammad Hassan Rahimian
Thesis: Simulation of liquid-bubble biphasic compressible flow using a Rayleigh-Plesset equation as the interface of phases by lattice Boltzmann method.

BSc: Mechanical engineering 2008-2012

Shahid Chamran University of Ahvaz, Ahvaz, Iran
Advisor: Dr. Amin Reza Noghreh Abadi
Thesis: Laminar Nano fluid flow in circular tube.

ACADEMIC EXPERIENCE

Teaching Assistant, Biomechanics	2019&2020
HPC compute Canada summer school participant (Linux shell, Python, R, Julia, OpenMP, MPI, CUDA)	2020
Teaching Assistant, Mechatronics	2020
Teaching Assistant, Thermo-Fluids Systems Design and Analysis	2017&2020

HONOURS & AWARDS

2018, HPC expenses-paid Scholarship International Summer School on HPC Challenges in Computational Sciences, to be held in Ostrava, Czech Republic, Europe.

2017, International Excellence Award, McMaster University, Canada.

RESEARCH AREAS OF INTEREST

Computational fluid dynamics (LBM, FVM, FDM, FEM, SPH).

Artificial intelligence and machine learning

Imaging processing (4D Flow MRI, MRI, CT, Echocardiography).

EDITORIAL ACTIVITIES

Reviewer, International Journal of Numerical Methods for Heat and Fluid Flow.

Reviewer, Computers and Fluids.

Reviewer, Journal of Thermal Analysis and Calorimetry.

Reviewer, Computers & Mathematics with Applications.

Reviewer, Journal of Porous Media.

PUBLICATIONS

Journal publication:

[1] Khodaei, S., Henstock, A., **Sadeghi, R**., Sellers, S., Blanke, P., Leipsic, J., Emadi, A. and Keshavarz-Motamed, Z., 2021, Personalized cardiology of mixed and complex cardiovascular diseases made possible with a non-invasive monitoring and diagnostic framework. *Scientific Reports.*

[2] Khodaei, S., **Sadeghi, R**., Blanke, P., Leipsic, J., Emadi, A. and Keshavarz-Motamed, Z., 2021. Towards a non-invasive computational diagnostic framework for personalized cardiology of transcatheter aortic valve replacement in interactions with complex valvular, ventricular and vascular disease. *International Journal of Mechanical Sciences*, p.106506.

[3] **Sadeghi, R**., Khodaei, S., Ganame, J. and Keshavarz-Motamed, Z., 2020. towards non-invasive computational-mechanics and imaging-based diagnostic framework for personalized cardiology for coarctation. *Scientific Reports*, *10*(1), pp.1-19.

[4] Nasiri, H., Jamalabadi, M.Y.A., **Sadeghi, R**., Safaei, M.R., Nguyen, T.K. and Shadloo, M.S., 2019. A smoothed particle hydrodynamics approach for numerical simulation of nano-fluid flows. *Journal of Thermal Analysis and Calorimetry*, *135*(3), pp.1733-1741.

[5] **Sadeghi, R**., Shadloo, M.S., Hopp-Hirschler, M., Hadjadj, A. and Nieken, U., 2018. Three-dimensional lattice Boltzmann simulations of high-density ratio two-phase flows in porous media. *Computers & Mathematics with Applications*, *75*(7), pp.2445-2465.

[6] Sadeghi, R. and Shadloo, M.S., 2017. Three-dimensional numerical investigation of film boiling by the lattice Boltzmann method. *Numerical Heat Transfer, Part A: Applications*, *71*(5), pp.560-574.

[7] **Sadeghi, R**., Shadloo, M.S. and Hooman, K., 2016. Numerical investigation of the natural convection film boiling around elliptical tubes. *Numerical Heat Transfer, Part A: Applications*, *70*(7), pp.707-722.

[8] **Sadeghi, R**., Shadloo, M.S., Jamalabadi, M.Y.A. and Karimipour, A., 2016. A three-dimensional lattice Boltzmann model for numerical investigation of bubble growth in pool boiling. *International Communications in Heat and Mass Transfer*, *79*, pp.58-66.

[9] **Sadeghi, R**. and Rahimyan, M.H. 2015. Simulation of bubble sonoluminescing phenomena with lattice Boltzmann method. *Modares Mechanical Engineering*, *15*(5), pp.383-391.

Conference publications:

[1] **Sadeghi, R**., Khodaei, S., and Keshavarz-Motamed, Z.,2018. Patient-specific simulation of coarctation using lattice Boltzmann method and lumped parameter modelling, Proceedings of the 27th Annual Conference of the CFDSC, 51-55.

[2] **Sadeghi, R**., Khodaei, S., Emadi, A. and Keshavarz-Motamed, Z.,2018. A look inside a heart with cardiomyopathy and transcatheter aortic valve replacement: An image-based fluid-structure interaction modeling study, Proceedings of the 27th Annual Conference of the CFDSC, 51-55.

Submitted publications:

[1] **Sadeghi, R**., Khodaei, S., Gasner, N., Garcia, J. and Keshavarz-Motamed, Z.,Risk quantification in patients with coarctation, requires evaluation of severity of mixed valvular disease and coarctation (Nature communication).

[2] **Sadeghi**, **R**., Tomka, B., Khodaei, S., Garcia, J., Ganame, J. and Keshavarz-Motamed, Z. Mixed and complex coarctation of the aorta: quantification and systematic differentiation using clinical measurements and image-based patient-specific in silico modeling (frontiers in bioengineering and biotechnology).

REFERENCES

Dr. Zahra Keshavarz Motamed, Assistant professor & director of cardiovascular research group, McMaster University, (motamedz@mcmaster.ca),

Dr. Mostafa Safdari Shadloo, Associate professor, CORIA Lab./ Institut National des Sciences Appliquées *de* Rouen, (mostafa.safdari-shadloo@insa-rouen.fr).

Dr. Julio Garcia. Assistant professor. Libin Cardiovascular Institute of Alberta - Stephenson Cardiac Imaging Centre, University of Calgary, (julio.garciaflores@ucalgary.ca)