Samuel Fagbemi

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HIGHLIGHTS

Research Scientist with 4 years of extensive experience in multiphase fluid-structure interaction in porous media, with the application of computational fluid dynamics (CFD), ***computational solid mechanics (CSM)***, fluid-structure interaction (FSI), CFD-discrete element method (CFD-DEM), and pore-network modeling techniques of capillary-dominated fluids in characterizing the two-way relationship between multiphase fluids and non-linearly deforming solid materials using digital imaging technology along with the utilization of High Performance Computing (HPC); possess in-depth knowledge of two-phase flow in ***hydrocarbon reservoirs***; possess extensive experience in 3D image analysis; experienced in the application of hydro-chemo-mechanical couplings for modeling flow in homogeneous systems; experienced in the application of machine learning in predicting rock properties; exhibit strong work ethic and desire to expand and develop innovative approaches to research; firm believer in the power of teamwork and collaborative effort; possess an excellent track record of publications in peer-reviewed journals.

EDUCATION

***Ph.D.*, Petroleum Engineering** – University of Wyoming, Laramie WY (Jan. '17 – Aug. '20)
***M.Sc.*, Petroleum Engineering** – University of Southern California, Los Angeles CA (Jan. '11 - May '13)
***B.Sc.*, Mechanical Engineering** – Kwame Nkrumah University of Technology, Ghana (Aug. '06 –July '10)
A-Level., Physical Sciences – Showers International College,Port Harcourt, Nigeria (Aug. '05 –Jul.'06)

PROFESSIONAL EXPERIENCE

Research Scientist Snr

- **Center of Innovation for Flow through Porous Media** (COIFPM), University of Wyoming (Sep. '20 – present)
  - Engender solutions for multiphase flow in small to intermediate-sized geometries using reliable and robust techniques to predict two phase permeability (relative permeability).
  - Predict flow behavior based on experimental data of contact angles during drainage simulations (when de-wetting fluid displaces wetting fluid) and reverse flow against gravity using Dynamic pore-network modeling (DPNM).
  - Obtaining capillary pressure curves for fluids that are capillary-regimented in large digital images in the order of 10^{10} voxels.
  - Build and develop multi-GPU interactive platform capable of carrying out image analysis of extra-large images, segmenting multiple phases of the images, and performing image registration using shared-memory parallelization.
  - Visualization of 2D and 3D images using Qt-VTK programming interface along with CUDA.
  - Solve large linear systems generated from quasi-dynamic and dynamic pore-network systems for different rock configurations using first- and second- generation graphic processing unit (GPU) server nodes to handle the dataset.
  - Matrices resulting from DPNM system analyzed for scaling by increasing the number of MPI processes and binding them to the GPUs present thus permitting several matrix partitions to be generated for greater computational efficiency.
  - Apply Multi-Process Service (MPS) server at the interface between GPUs and MPI processes for better communication management between them.

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- Perform strong scaling analysis for large linear problems by employing PETSC, AmgX and AmgX-PETSC wrapper on Nvidia DGX-Station for cases where the matrix system was pre-decomposed using Metis for graph partitioning, and for cases pre-assembled before solving the linear system.
- Planning activities carried out such as creating Gannt chart for present and incoming researchers.
- Implementing hardware system roadmap to be utilized by research team; and reviewing proposals.

Research Assistant

- **Department of Energy** - DOE award number: DE-FE0031787 (Oct. '19 – Aug. '20)
  Award recipient: University of Wyoming
  Project: Field Pilot Test of Foam-assisted Hydrocarbon Gas Injection in Bakken Formations
  - Direct micro-scale modeling using steady-state finite volume single-phase flow technique, with images acquired from FIB-SEM technology.
  - Image pre-processing using linear stack alignment and image enhancement achieved by utilizing 3D median filtering and then segmenting them.
  - Computation of absolute permeability, pore-volume fraction, and obtaining of pore-size distribution (PSD) of the sample.
  - Application of convolutional neural networks (CNN) for predicting petrophysical properties as well as carrying out transport simulations and prediction of the breakthrough of solutes with different diffusivities.

Research Assistant

- **Department of Petroleum Engineering**, University of Wyoming, Laramie WY (Jan. '17 – Jul. '20)
  High Bay Research Facility (HBRF), Center of Innovation for Flow through Porous Media (COIFPM)
  Primary Research (Upscaled Fluid-Solid interaction and High-Performance Computing):
  - Characterizing of non-linear deformation patterns in heterogenous porous media based on variations in Reynolds number using loosely-coupled and tightly-coupled fluid-structure interaction approaches at the micro-scale.
  - Modeling multi-phase fluid-solid interaction by applying Volume of Fluid (VOF) discretized on unstructured collocated finite volume mesh.
  - Parallelization achieved using domain decomposition. Parallel runs actualized on supercomputing cluster while employing 200 cores for accelerating computations by more than 20%.
  - Study of static and dynamic droplet deformation on soft substrate applied for model verification.
  - Droplet model verified against experimental work and it produced accurate results for contact angles greater than 90 degrees. Contact angles less than 90 degrees produced less accurate results.
  - Study of elastic deformation in microfluidic device using coupled multiphase fluid-solid model carried out.
  - Multiphase fluid introduced into Y-shaped microchannel to interact with integrated parallel quadrilateral-shaped plates located midway across the fluid-solid interaction zone.
  - Simulation predicted fluid flow effecting larger deformation in constricted regions due to high viscous forces and capillary pressure in narrow throats, whereas less deformation was induced at wider regions.

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Geomechanical and geostatistical analysis:

- Investigation of effects of uniaxial and triaxial boundary loads in decoupled fluid-structure system at micro-scale.
- Micro-scale simulation resulted in stress-induced changes for fluid occupancy, velocity field distribution and relative permeability of multiphase flow.
- Application of Abaqus in testing failure of sandstone using Mohr-Coulomb yield criterion, and non-linear elastic behavior during loading processes.
- Analysis of 2D and 3D continuous and categorical data in sandstone reservoirs by ordinary kriging (OK), sequential Gaussian Simulation (SGSIM), and multiple-point geostatistical (MPS) methods such as single normal equation simulation (SNESIM), and Filter-based Simulation (FILTERSIM).
- Application of machine learning for predicting shale and sandstone properties from extracted log data.

Discrete Element Modeling (DEM) and Pore-network modeling:

- Development of framework for investigating effect of wettability in resolved and unresolved CFD-DEM systems via application of VOF.
- Development of fully coupled pore-network and finite element model while implementing convex-hull methodology and nodal interpolation. Based on sensitivity analyses, model achieved higher accuracy for simulations with large number of test points.

Non-technical duties:

- Coordination of team meetings to keep projects on track.
- Collaboration with supervisor on research plans and propose new ideas and initiatives.
- Collaboration with several Ph.D. students and assisting them in implementing and examining their research.

Lecturer

- **Department of Petroleum Engineering**, University of Wyoming, Laramie WY
  - Introduction to computing, PETE 2020 (Sep.'19 – Oct. '19)
  - Well testing, PETE 4225 (Teaching Assistant) (Sep. '17 – Dec. '17)
  - Dynamics, PETE 2050 (Jun. '17 – July. '17)

Graduate Assistant

- **Department of Mechanical Engineering**, Texas A&M University - Kingsville, Kingsville TX (Sep. '16 – Dec. '16)
  - Design and manufacture of pleated rubber muscle actuators (RMAs).
  - 3D printing of RMAs in a Connex 3D printer.
  - Fiber-reinforced plastic design and manufacture.

Climate Lobbyist

- **Citizens Climate Lobby,** Houston, TX (Jul. '15 – Dec. '15)
  - Spearheaded the enlightenment of the public and members of Congress regarding the ills of excessive carbon emissions in the society and ways to mitigate them.
  - Through combined efforts of a nationwide network of volunteers and mine, the organization was able to introduce the first bipartisan carbon pricing bill in the US House in 2019.

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Internship

- **ExxonMobil, Mobil Producing Nigeria (MPN)**, Ibeno Akwa-Ibom, Nigeria (Jun.'09–Aug.'09)
  - Performed daily preventive and reactive maintenance on a wide range of triplex positive-displacement and centrifugal pumps from various ESSO exploration and offshore downstream facilities.
  - Extensive brainstorming, failure evaluation, pump-rebuilding and replacement of suction and discharge valves mounted in the head of the cylinder, as well as gasket and O-ring replacement.
  - Maintained meticulous records of scheduled maintenance, and upcoming projects.

Internship

- **ExxonMobil, Mobil Producing Nigeria (MPN)**, Ibeno Akwa-Ibom, Nigeria (May'08–Jul.'08)
  - Process engineer on $1.3bn offshore platform, designed to gather gas from all the MPN fields, compress, extract NGL and inject lean gas to recover 275m barrels of natural gas liquids from associated gas produced in the East Area reservoirs. The first of its kind in West Africa.
  - Utilized effective system infrastructure, data management and interpretation techniques for achieving flow control, monitoring, and optimization of the facility.
  - Real-time monitoring of incoming gas and quantity being converted to NGL.
  - Performed daily preventive maintenance on 18,000-tonne gas compression facilities and turbines that set a world record when installed in open water using Float-Over Technology.
  - Analyzed and interpreted P&IDs, technical drawings, schematics and computer-generated reports.

LETTER-GRADE CLASSES

- Transport phenomena (PETE 5010)
- Advanced Manufacturing (MEN 5301)
- Flow through Porous media (PETE 5060)
- Advanced Finite Element Analysis (MEN 5980)
- Continuum mechanics (MEN 5330)
- Machine Learning (GEOL 5890)
- Mathematical methods for engineers (PETE 5355)
- Research Methods (PETE 5100)
- Geostatistics and subsurface characterization (PETE 5320)
- Interfacial Phenomena (PETE 5080)

ADDITIONAL SKILLS

- ***Finite element (FE)***, and finite volume (FV) modeling for solid mechanics, fluid dynamics, and FSI
- OpenFOAM (Open-CFD) simulation, COMSOL
- Pore-network modeling
- High Performance Computing (HPC)
- PETSC, KOKKOS, AmgX linear solver systems
- MPI and OpenMP parallelization
- CUDA programming

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- Machine learning
- C and C++ programming, Python, Java, MATLAB
- Computational fluid (dynamics)-discrete element method (CFDEM) modeling
- 3D printing, CAD/CAM, SolidWorks

AWARDS & LICENSES

- Harry Hill Graduate Excellence Award, University of Wyoming (May '19)
- Microsoft Technical Associate certification (MTA) (May '15)
- Petrel Workflow, NeXT, Schlumberger certification, (Sep. '14)
- Floyd L. Kallam Award $3138, University of Southern California (Jan. '13)
- Floyd L. Kallam Award $4707, University of Southern California (Aug. '12)

PROFESSIONAL ASSOCIATIONS

- Society of Petroleum Engineers (SPE)
- Society of Exploration Geophysicists (SEG)
- American Society of Mechanical Engineers (ASME)
- Society of Industrial and Applied Mathematicians (SIAM)
- International Association for Computational Mechanics (IACM)
- United States Association for Computational Mechanics (USACM)
- International Society for Porous Media (InterPore)

PUBLICATIONS AND CONFERENCE PRESENTATIONS

Peer-Reviewed Journal Publications:

- X. Zhang, **S. Fagbemi**, P. Tahmasebi (2021), "Granular materials: A review"; *Progress in Materials Science, (under preparation)*.
- Y. Wu, C. Lin, **S. Fagbemi**, P. Tahmasebi, S. An, K. Liu (2021); Two-phase Flow Simulation of Oil and Water and Analysis of Microscopic Remaining Oil Based on Multiscale Digital Cores; *Petroleum Exploration and Development*, (*under preparation)*.
- T. Davydzenka, **S. Fagbemi**, P. Tahmasebi (2020); "Coupled Fine-Scale Modeling of the Wettability Effects: Deformation and Fracturing"; *Physics of Fluids 32 (8), 083308.*
- T. Davydzenka, **S. Fagbemi**, P. Tahmasebi (2020); "Wettability Control on Deformation: A Coupled Multiphase Fluid and Granular System"; *Physical Review E 102 (1), 013301.*
- **S. Fagbemi**, P. Tahmasebi, and M. Piri (2020); "Elastocapillarity Modeling of Multiphase Flow-Induced Solid Deformation using Volume of Fluid Method"*; Journal of Computational Physics 421 (2020): 109641.*
- **S. Fagbemi**, P. Tahmasebi (2020); "Pore-scale Coupling of Porous Media Processes Using Pore-Network and Finite Element Method", *Journal of Fluid Mechanics.*
- **S. Fagbemi**, P. Tahmasebi, and M. Piri (2020); "Strongly coupled Multiphase Flow-induced solid deformation using Finite Volume Method", *International Journal for Numerical and Analytical Methods in Geomechanics.*, Volume 44, Issue 2, DOI: 10.1002/nag.2999
- **S. Fagbemi**, P. Tahmasebi, M. Piri (2018); "Pore-scale Modeling of Multiphase Flow through Porous Media under Triaxial Stress". *Advances in Water Resources*, 122: 206-216, DOI: 10.1016/j.advwatres.2018.10.018
- **S. Fagbemi**, P. Tahmasebi, and M. Piri (2018); "Interaction between fluid and porous media with complex geometries: A direct pore-scale study", *Water Resources Research*, 54: 6336–6356, DOI: 10.1029/2017WR022242

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Conference presentations:

- **S. Fagbemi**, (2019), Fluid-solid interaction in porous media, 1st Annual Meeting, Society of Industrial and Applied Mathematics (SIAM) Northern States Section, at the University of Wyoming, September 27th- 29th, 2019