

# Oluwamayowa Amusat

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## RESEARCH INTERESTS

My research interests lie in the area of computer-aided process engineering: the incorporation of the latest advances in modelling, optimization, machine learning and decision support techniques to the improvement and enhancement of process systems. I am currently working on developing data-driven modelling and machine learning techniques to support the design of advanced energy and water desalination systems. The work is part of the DOE-funded [IDAES Project](#) and explores the interface between machine learning, operations research and process systems engineering.

## Research Position

**Postdoctoral Researcher**, Lawrence Berkeley National Laboratory, CA      February 2019 – Present

Working on the IDAES Process Systems Engineering (IDAES PSE) Framework, a next generation multi-scale modeling and optimization Framework to support the US power industry. The project is funded by the US Department of Energy's Office of Fossil Energy through the Simulation-Based Engineering, Crosscutting Research Program.

I am developing equation-oriented surrogate modelling tools to aid in the design and optimization of advanced energy systems. The tools provide a way for important legacy simulations and pilot-stage energy generation technologies to be integrated into the IDAES PSE framework for techno-economic analysis and performance optimization.

## Qualifications

**Ph.D., Chemical Engineering**      University College London, United Kingdom      2013 - 2017

- » Thesis: *Design and optimization of hybrid renewable energy systems for off-grid continuous operations*
- » Advisors: Eric S. Fraga, Ph.D and Paul R. Shearing, Ph.D
- » Examiners: Dr. Franco Cecelja (University of Surrey) and Dr. Federico Galvanin (UCL)

**M.S., Chemical Engineering**      University of Leeds, United Kingdom      2012 - 2013

- » Thesis: *Dynamic modelling and simulation of CO<sub>2</sub> capture in packed columns*
- » Advisor: Tariq Mahmud, Ph.D
- » Graduated with Distinction

**B.S., Chemical Engineering**      Obafemi Awolowo University, Nigeria      2005 - 2010

- » First class honours

## ▶▶▶ Ongoing and Recent Projects

### **NAWI Project / ProteusLib: Validation of water desalination process models**

*Ongoing*

This work is being done as part of the [NAWI](#), a DOE-funded Energy-Water Desalination Hub.

I am working with a team of national laboratory researchers and scientists on the validation of the developed ProteusLib process models against operational data from a number of industrial and pilot water desalination facilities across the United States.

### **ScienceSearch for JGI: Enabling search across multi-omics data**

*Ongoing*

This work is being done as part of the [ScienceSearch project](#), a platform that enables search across different types of scientific data. ScienceSearch is funded out of the Office of Advanced Scientific Computing Research (ASCR), U.S. Department of Energy.

In collaboration with the Joint Genomics Institute (JGI) at Berkeley Lab, I am developing unsupervised learning and NLP techniques for automated metadata generation from biological and multi-omics data. The generated metadata will allow us to create relationships between different JGI data sources such as proposals, publications and images, thereby enabling scientific search.

### **Process models for biomass generation**

2018

Developed material balance, energy balance and performance evaluation models for a pilot biomass power generation system.

### **Development of energy recovery optimization solutions for incineration systems**

2017

Developed (in conjunction with the technical team at Inciner8 International) a VBA-based simulation platform for energy recovery optimisation in thermal waste treatment plants. The developed platform carries out material and energy balances for stage-wise combustion chambers, evaluates emission levels, sizes ceramic filters and carries out optimizations for steam generation and electricity production from heat recovery.

## ▶▶▶ Awards and Honours

### **Winner, DAI Best Paper Award,**

2018

Awarded by Digital Applications International Limited (DAI) for the best paper published in 2017, authored or co-authored by a UCL Engineering student.

### **Winner, Chemical Engineering MSc prize,**

2013

Awarded by the University of Leeds to the student with the best overall performance on the MSc Chemical Engineering programme.

### **Winner, Best Taught Postgraduate Finalist Prize,**

2013

Awarded by the University of Leeds to the student with the best overall performance on a SPEME taught MSc programme.

### **SPEME Excellence Scholarship,**

2012

Awarded by the University of Leeds in recognition of academic achievement and excellence.

### **Presidential Special Scholarship Scheme for Innovation and Development (PRESSID) Award,** 2012

Merit-based postgraduate scholarship awarded by the Nigerian government through the National Universities Commission (NUC) in recognition of academic excellence.

**Winner, West African Portland Cement Company (WAPCO) Prize,**

2010

Awarded by WAPCO to the best graduating chemical engineering student in process design.

**Winner, Chemical Engineering Prize (O.A.U. Alumni '74),**

2010

Alumni prize awarded to the best graduating student in engineering economics and management in the Department of Chemical Engineering.

### »»» Academic & Industrial Experience

**Quintas Renewable Energy Solutions**

August 2018 - December 2018

*Process Engineering Consultant**Ondo State, Nigeria*

Responsibilities: Providing process engineering technical expertise on the development and deployment of biomass power generation technologies in Nigeria. Achievements included:

- Provided process engineering expertise on the deployment of a 200kW off-grid biomass power plant in Idanre LGA, Ondo state.
- Developed shortcut models to estimate the performance of the biomass boiler system.
- Contributed to the sizing of water-in-tube boilers and steam generators for the biomass power generation system.
- Developed mass and energy balance models for the overall waste-to-energy system, from biomass gasification to steam generation.

**University College London**

November 2014 - July 2017

*Thesis co-supervisor**London, United Kingdom*

- Co-supervised two masters-level students working on the heat exchanger and thermal energy storage problems.
- Guided the students in preparation and presentation of research findings.

**University College London**

November 2014 - July 2016

*Graduate Teaching Assistant: Computational modelling and analysis**London, United Kingdom*

Responsibilities included:

- Providing first year chemical engineering undergraduates with a hands-on introduction to the use of process simulation and optimization tools such as GAMS, gPROMs and MATLAB.
- Graded courseworks and reports to ensure students understood material and stayed on track.
- Mentoring and advising undergraduates and postgraduates on optimization-related projects.

### »»» Selected Refereed Publications

**Oluwamayowa O. Amusat**, John D. Siirola, Deb A. Agarwal and Dan Gunter. "pyomo.contrib.surrogates: A Pyomo-based framework for surrogate model generation", *9th International Conference on the Foundations of Computer-Aided Process Design (FOCAPD)*, Colorado, USA, July 2019.

**Oluwamayowa O. Amusat**, Paul R. Shearing, and Eric S. Fraga. [Optimal design of energy systems incorporating stochastic renewable resources fluctuations](#). *Journal of Energy Storage*, 15:379-399, Feb 2018.

**Oluwamayowa O. Amusat**, Paul R. Shearing, and Eric S. Fraga. On the design of complex energy systems: Accounting for renewables variability in systems sizing. *Computers & Chemical Engineering*, 103:103-115, Aug 2017.

Eric S. Fraga and **Oluwamayowa Amusat**. Understanding the impact of constraints: A rank based fitness function for evolutionary methods. *Advances in Stochastic and Deterministic Global Optimization*, pages 243-254. Springer International Publishing, Cham, 2016.

**Oluwamayowa O. Amusat**, Paul R. Shearing, and Eric S. Fraga. Optimal integrated energy systems design incorporating variable renewable energy sources. *Computers & Chemical Engineering*, 95:21-37, Dec 2016.

**Oluwamayowa O. Amusat**, Paul R. Shearing, and Eric S. Fraga. Reliable energy systems design for continuous processes incorporating renewables generation. In Zdravko Kravanja and Milo Bogataj, editors, *26th European Symposium on Computer Aided Process Engineering*, volume 38 of *Computer Aided Chemical Engineering*, pages 469-474. Elsevier, 2016.

**Oluwamayowa O. Amusat**, Paul R. Shearing, and Eric S. Fraga. System design of renewable energy generation and storage alternatives for large scale continuous processes. In Krist V. Gernaey, Jakob K. Huusom, and Raqul Gani, editors, *Computer Aided Chemical Engineering*, volume 37, pages 2279-2284. Elsevier, 2015.

## Selected Talks and Presentations

### Oral Presentations

- "Data-driven models for equation-oriented optimization", *Berkeley Lab Postdoctoral Symposium*, 2021.
- "Assessing the impact of renewables intermittency on the sizing of standalone hybrid energy systems incorporating storage", **Keynote speaker**, *2nd Renewable Energy Sources - Research and Business conference (RESRB 2017)*, Wroclaw, Poland, June 2017.
- "On the design of standalone renewable energy systems: Accounting for Inter-year Variability in Systems Sizing", Speaker, *Workshop on complexity and risk in the energy sector*, London, UK, October 2016.
- "Multi-objective design of standalone renewables-based hybrid energy systems for off-grid Mining", Speaker, *EGL 2016 workshop on numerical mathematics*, London, UK, June 2016.
- "Reliable energy systems design for continuous processes incorporating renewables generation", **Paper Presentation**, *26th European Symposium on Computer Aided Process Engineering*, Portoroz, Slovenia, June 2016.
- "Optimal integrated energy Systems design incorporating Variable Renewable Energy Sources", Speaker, *3rd PRO-TEM Network Conference: Sustainable Thermal Energy Management in the Process Industries (SusTEM2015)*, Newcastle, UK, July 2015.
- "System design of renewable energy generation and storage alternatives for large scale continuous processes", **Paper Presentation**, *12th International Symposium on Process Systems Engineering and 25th European Symposium on Computer Aided Process Engineering*, Copenhagen, Denmark, June 2015.

### Poster Presentations

- "PySMO: An easy-to-use computational tool for surrogate model generation and surrogate-assisted optimization", *CAPD Annual Review Meeting*, Pittsburgh, USA, March 2020.

- "idaes.surrogates: A Pyomo-based framework for surrogate model generation", *9th International Conference on the Foundations of Computer-Aided Process Design (FOCAPD)*, Colorado, USA, July 2019.
- "Power quality management for off-grid hybrid renewable energy systems", *UCL Industrial Advisory Board (IAB) meeting*, London, UK, February 2017.
- "Renewable energy storage for continuous processes: A case study of mining", *UK Energy Storage (UKES) conference*, Warwick, UK, 2014.

## Professional Memberships

- Senior member, *American Institute of Chemical Engineers*
- Member, *Institute for Operations Research and the Management Sciences (INFORMS)*.
- Associate member, *Institution of Chemical Engineers (AMIChemE)*
- Associate member, *Energy Institute (AMEI)*

## Commissions of Trust

- **Reviewer**, *Environmental Technology Innovation*, 2020 - Present
- **Reviewer**, *Applied Energy*, 2019 - Present
- **Scientific Advisory Board (SAB) member**, 3rd Renewable Energy Sources - Research and Business (RESRB) conference, Belgium, 2018.
- **Session Chair**, Oral Session 3: System evaluation and control, 2nd Renewable Energy Sources - Research and Business (RESRB) conference, Poland, 2017.
- **Scientific Advisory Board (SAB) member**, 2nd Renewable Energy Sources - Research and Business (RESRB) conference, Poland, 2017.
- **Reviewer**, *Engineering & Technology Reference*, 2016.
- **Organizing member**, EGL workshop on numerical mathematics, London, 2016.
- **Organizing member**, UCL Chemical Engineering Summer Challenge, London, 2016.

## Technical Skills & Expertise

Relevant expertise acquired through education and work experience:-

### Machine Learning:

- Supervised and unsupervised learning - linear and logistic regression, MLP neural networks, k-means clustering, dimensionality reduction.
- Natural language processing (NLP) analysis (TextRank, TF-IDF) - limited experience.
- Data preparation and pre-processing for ML analysis.

- Data down-sampling techniques.

### **Reduced Order Modelling (ROM):**

- Reduced order modelling - Kriging, RBFs, SVR, Polynomial regression.
- Surrogate integration into numerical optimization, including trust region analysis.
- Surrogate assisted optimization.

### **Mathematical Optimization:**

- Deterministic and stochastic/black-box optimization optimization of NLP and MINLP systems.
- Single- and multi-objective optimization.
- Optimization algorithm design, e.g Strawberry
- Tools: Pyomo, GAMS, SciPy

### **Numerical Analysis:**

- Numerical solutions to Differential-Algebraic Equation (DAE) systems.
- Statistical and probabilistic modelling and analysis.
- Time-series analysis.
- Model validation and uncertainty quantification.

**Programming:** Python, MATLAB, Octave.

## **Referees**

### 1. Daniel Gunter

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### 2. Eric S. Fraga, PhD

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