

# Gayathri KRISHNAMOORTHY

## Electrical Engineer| Computer Scientist

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Power Systems Engineer with 6+ years of experience as a researcher at National Laboratories and Washington State University. Worked on several projects developing theories, models, and software tools to efficiently integrate renewable energy resources while making them a significant player in energy markets. I am outgoing, creative, and detail-oriented with strong engineering basics and communication skills. I am effective both solo or on a team. In my spare time I practice yoga, dance, and painting. I am also passionate about journalism and the brain science behind mindfulness practice.

## PROFESSIONAL EXPERIENCE

|                                  |   |
|----------------------------------|---|
| Present<br>Jan 2022              | <b>Researcher, NATIONAL RENEWABLE ENERGY LABORATORY (NREL), Golden, CO</b> <ul style="list-style-type: none"><li>➤ Developing synthetic distribution grid infrastructure layer for the U.S. grid using licensed and open source geospatial data hosted by multiple utilities and cloud platforms.</li><li>➤ Developing an upgrade cost database framework to evaluate the power system level operational violations with the increasing integration of fast charging electric vehicle stations and proposing least cost optimal component upgrades.</li><li>➤ Leading the writing on a lab wide effort to present to the U.S. congress on current state and evolution of the power distribution grid with a focus on Cybersecurity needs.</li></ul> <div>PostgreSQL QGIS Julia Python HELICS PyDSS</div>  |
| Dec 2021<br>Aug 2016             | <b>Graduate Research Assistant, WASHINGTON STATE UNIVERSITY, Pullman, WA</b> <ul style="list-style-type: none"><li>➤ Developed imitation learning based improvements to incorporate the physics of power distribution grid models in data driven solution approaches (deep reinforcement learning models).</li><li>➤ Developed efficient regulation market techniques to enable transmission level frequency regulation service provision using distribution connected battery energy storage systems.</li><li>➤ Developed analytical models to demonstrate the convergence of transmission and distribution grid co-simulation platforms.</li><li>➤ Developed an optimal retail market model and performed impact assessment of demand-side renewable resource participation and its integration into the wholesale market.</li></ul> <div>Python MATLAB OpenDSS PSAT Tensorflow Keras</div> |
| May - Aug 2020<br>May - Dec 2018 | <b>Graduate Research Intern, PACIFIC NORTHWEST NATIONAL LABORATORY, Seattle, WA</b> <ul style="list-style-type: none"><li>➤ Developed deep reinforcement learning models to perform AC optimal power flow for the power transmission system optimization.</li><li>➤ Assisted in development of a transactive energy software agent, TESP, that optimizes the dynamics of distributed energy resources in a household and bids the excess energy in the energy market to provide monetary benefits to the costumers using electric vehicles, batteries, and PVs.</li><li>➤ Performed scalability testing for the open source co-simulation platform (HELICS) in multiple environments.</li><li>➤ Developed docker environment for a microgrid restoration application with HELICS.</li></ul> <div>C++ MATPOWER GridLAB-D OpenDSS Docker EnergyPlus HELICS</div>                                |
| May 2022<br>May 2021             | <b>Columnist, THE DAILY EVERGREEN, Pullman, WA</b> <ul style="list-style-type: none"><li>➤ Worked on many sections to encourage and support women pursuing graduate studies in the United States.</li><li>➤ Helping international students acclimate to the cultural and workplace differences in and around the university.</li></ul>  |

|          |   |
|----------|---|
| Dec 2019 | <b>Graduate Teaching Assistant, WASHINGTON STATE UNIVERSITY, Pullman, WA</b>  |
| Jan 2019 | Courses : Numerical Computing for Engineers, Professional Skills in Computing and Engineering<br>Tasks : <ul style="list-style-type: none"> <li>&gt; Engaged classes of 100+ undergraduate (multiple engineering discipline) students</li> <li>&gt; Helped the class in learning to use MATLAB (a professional computing software) and Microsoft project professional softwares</li> <li>&gt; Provided my best efforts in evaluating students' homeworks and exams</li> </ul> |

Microsoft Project Professional   LaTeX

## EDUCATION

|          |  |
|----------|--|
| Dec 2022 | <b>Ph.D. in Electrical Engineering , WASHINGTON STATE UNIVERSITY, Pullman, WA</b>  |
| Jan 2019 | <ul style="list-style-type: none"> <li>&gt; Research : Learning Method based Enhancements to enable Frequency Regulation Service Provision from Distribution Connected Energy Storage Systems</li> <li>&gt; Major : Power Systems</li> <li>&gt; Minor : Computer Science</li> <li>&gt; Advisor : Dr. Anamika Dubey (WSU)</li> <li>&gt; Co-Advisors : Dr. Anjan Bose (WSU), Dr. Mani Venkatasubramanian (WSU), and Dr. Laurentiu Marinovici (PNNL)</li> </ul> |
| May 2018 | <b>M.S. in Electrical Engineering, WASHINGTON STATE UNIVERSITY, Pullman, WA</b>  |
| Aug 2016 | <ul style="list-style-type: none"> <li>&gt; Research : An Iterative Co-simulation Framework for the Integrated Transmission and Distribution System Analysis</li> <li>&gt; Major : Power Systems</li> <li>&gt; Minor : Computer Engineering</li> <li>&gt; Advisor : Dr. Anamika Dubey (WSU)</li> </ul>   |
| May 2016 | <b>B.E. in Electronics and Communications Engineering, ANNA UNIVERSITY, Chennai, India</b>   |
| Aug 2012 | <ul style="list-style-type: none"> <li>&gt; Title : Smart Home Design with Voice Recognition in a Single Controller (Arduino Uno) Environment</li> <li>&gt; Major : Embedded Systems</li> <li>&gt; Minor : Communications</li> <li>&gt; Advisor : Dr. Suresh T</li> </ul>  |

## PROJECTS

### MODEL-BASED AND MODEL-FREE DISTRIBUTION SYSTEM OPTIMIZATION USING DEEP REINFORCEMENT LEARNING 2020 - PRESENT

 [github.com/gayukrishna/DRL-for-Secondary-Control-Services](https://github.com/gayukrishna/DRL-for-Secondary-Control-Services)

I developed an optimization strategy (model-based) and DRL techniques (model-free) to distribute and maintain the scheduled frequency regulation dispatch from the ISO using battery energy storage systems. I also use imitation learning models to enhance the reinforcement learning performance for larger test systems.

Python   Tensorflow   Keras

### L2RPN WCCI AND NEURIPS CHALLENGE - ADAPTABILITY TRACK

2020

 [NeurIPS 2020](#)

This challenge is the latest round in a series of power network control challenges organized by RTE France (electricity transmission system operator of France). The goal was to control electricity transport in power networks running closer to their operational limits while keeping people and equipment safe. I participated/led two teams (one at WSU and one at PNNL) and successfully stood in the leader board up to the final phase.

Grid2Op   OpenAI Gym   Python   Tensorflow

## TRANSMISSION -DISTRIBUTION CO-SIMULATION

2017 - 2019

[github.com/WSU-DS/Cosimulation](https://github.com/WSU-DS/Cosimulation) [PSERC T-60](#)

This is my master's thesis work. Here, I developed a framework for the integrated T&D system analysis to understand the impacts of distribution-connected renewable resources (DERs) on transmission system operations and vice-versa (project funded by PSERC). Also, using the co-simulation framework developed, I explored the utility of DER's in transmission system support.

MATLAB OpenDSS Python Git

## GMLC-TDC/ HELICS

2018-2019

[github.com/GMLC-TDC](https://github.com/GMLC-TDC) [github.com/GMLC-TDC/MATPOWER-wrapper](https://github.com/GMLC-TDC/MATPOWER-wrapper) [HELICS](#)

HELICS is a coordinated effort by multiple National Labs to develop a large scale real-time simulation platform that aids advanced power system operations. I worked on certain aspects of the development like scalability testing and wrapper development for power system tools like Matpower and PSAT.

C++ Python MATLAB Matpower Git

## TESP

2018

[github.com/pnnl/tesp](https://github.com/pnnl/tesp) [TESP](#)

For this project, I was involved in developing the energy market structure (real-time and day-ahead) for HVAC (heating, ventilation and air conditioning) systems. The major tasks were to develop consensual bidding strategies and to test/validate on large scale power system networks.

Python C++ GridLAB-D EnergyPlus Git Linux

## PROGRAMMING SKILLS

|            |   |   |   |   |   |
|------------|---|---|---|---|---|
| Python     | ● | ● | ● | ● | ● |
| Julia      | ● | ● | ● | ● | ● |
| MATLAB     | ● | ● | ● | ● | ● |
| C++        | ● | ● | ● | ● | ○ |
| HTML       | ● | ● | ● | ○ | ○ |
| Javascript | ● | ● | ● | ○ | ○ |
| CSS        | ● | ● | ● | ○ | ○ |

## SIMULATION TOOLS

- > QGIS
- > PyTorch
- > Tensorflow
- > Docker
- > OpenAI Gym
- > HELICS
- > Grid2Op
- > OpenDSS

## OFFICE SKILLS

- > LaTeX
- > MS Presentation
- > MS Excel
- > MS Word
- > MS OneNote
- > MS Visio
- > Visual Studio (VSCode)

## PUBLICATIONS

- |      |   |
|------|---|
| 2022 | G. Krishnamoorthy, A. Dubey and A. Gebremedhin, "An Open-source Environment for Reinforcement Learning in Power Distribution Systems," in 2022 IEEE Power & Energy Society General Meeting (PESGM).                 |
| 2021 | G. Krishnamoorthy, A. Dubey and A. Gebremedhin "Reinforcement Learning for Battery Energy Storage Dispatch augmented with Model-based Optimizer," in IEEE SmartGridComm 2021.                                       |
| 2019 | G. Krishnamoorthy and A. Dubey, "Transmission-Distribution Cosimulation : Analytical Methods for Iterative Coupling," in IEEE Systems Journal 2019.   |
| 2019 | J. C. Bedoya, C. Liu, G. Krishnamoorthy and A. Dubey, "Bilateral Electricity Market in a Distribution System Environment," in IEEE Transactions on Smart Grid 2019.   |
| 2019 | Sen, P.K., Velaga, Y.N., Chen, A., Krishnamoorthy, G. and Dubey, A., 2019, "Advancements in Co-Simulation Techniques in Combined Transmission & Distribution Systems Analysis," in The Journal of Engineering 2019. |
| 2019 | G. Krishnamoorthy, A. Dubey and P. K. Sen, "Iteratively-Coupled Co-simulation Framework for Unbalanced Transmission-Distribution System," in 2019 IEEE Milan PowerTech, Milan, Italy, 2019.                         |
| 2018 | Krishnamoorthy, Gayathri, and Anamika Dubey. "A framework to analyze interactions between transmission and distribution systems," in 2018 IEEE Power & Energy Society General Meeting (PESGM).                      |

## OTHER PROFESSIONAL ACTIVITIES

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|------------------|---|
| Present          | Serving as a Global Graduate Students Team Leader at the Society of Women Engineers   |
| Present          | Serving as a reviewer for IEEE Power and Energy Society Conferences, Institution of Engineering and Technology Journals, and IEEE Systems Journal |
| 2020             | Participated in WCCI and NeurIPS 2020 learning to run power network challenges  |
| 2019             | Authored a Ph.D. Research Proposal to Pacific Northwest National Laboratory   |
| 2020, 2018, 2017 | Paper and Poster Presentations- IEEE PES General Meeting, Power Systems Engineering Research Center   |

## HONORS AND AWARDS

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- 2022 **Awardee** Best Conference Paper at IEEE Power and Energy Society General Meeting
- 2020 **1st Place** 3-Minute Thesis Competition at WSU Electrical Engineering and Computer Science Department
- 2019, 2020 **Awardee** Graduate & Professional Student Association Scholarship for the Research Exposition
- 2018 **2nd Place** Best Student Paper Award at North American Power Symposium
- 2015 **2nd Place** Texas Instruments India Analog Maker Competition
- 2014 **Awardee** Level 1 Cambridge English Language Assessment in Business English

## REFERENCES

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### Anamika Dubey

*Research Advisor, WSU*

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### Nadia Panossian

*Co-worker, NREL*

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### Laurentiu Marinovici

*Internship Mentor, PNNL*

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