**Yifeng Hu, Ph.D., P.E.**



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## EDUCATION

**Ph.D.** in Architectural Engineering, University of Nebraska – Lincoln, 2018/1 – 2021/8

Dissertation: *Development and Demonstration of a Method to Determine Residential Air-Conditioning System Fault Prevalence*

Advisor: David P. Yuill

GPA: 4.0/4.0

**M.S.** in Heating, Ventilation, and Air Conditioning Engineering, Tongji University, 2011/9 – 2014/3

Thesis: *Study of Influence of Transportation System on Energy Efficiency of Ground Coupled Heat Pump System*

Advisor: Hongwei Tan

GPA: 3.4/4.0

**B.E.** in Building Environment and Equipment Engineering, Southwest University of Science and Technology, 2007/9 – 2011/6

Undergraduate Design Project: *Air-Conditioning System Design of an Office Building of Liyuan Group in Chengdu*

GPA: 3.5/4.0

## PROFESSIONAL EXPERIENCE

**R&D Associate Staff Member,** Building Equipment Group, UT BATTELLE LLC ORNL, Oak Ridge, Tennessee, 2023/6 – present.

**Postdoctoral Research Associate,** Durham School of Architectural Engineering and Construction, University of Nebraska – Lincoln, Omaha, Nebraska, 2021/10-2023/5.

**Graduate Research Assistant,** Durham School of Architectural Engineering and Construction, University of Nebraska – Lincoln, Omaha, Nebraska, 2019/6 – 2021/8.

**Graduate Teaching Assistant,** Durham School of Architectural Engineering and Construction, University of Nebraska – Lincoln, Omaha, Nebraska, 2018/1 – 2019/5.

**HVAC Engineer,** Architects & Engineers, Co., Ltd. of Southeast University, Nanjing, China, 2014/4 – 2017/11.

## RESEARCH INTERESTS

* Design, Modeling, and Test of HVAC systems.
* Fault Detection and Diagnostics (FDD) for HVAC systems
* Virtual Calibration, Virtual Sensing, and Soft Repair
* Heat pump technologies
* Flow boiling and condensation
* Thermoelectric cooling and heating

## RESEARCH PROJECTS

* Cold Climate Heat Pump using Vapor Compression Cycle Cascaded with a Thermoelectric Heat Pump, DOE, 2022-2025
* Design, fabricate, and test a cold climate heat pump using a vapor compression cycle cascaded with a thermoelectric heat pump.
* Dual-Evaporator, Variable-Capacity Refrigerator, Coupled with Thermo-electric Freezer (TER), DOE, 2022-2025
* Design, fabricate, and test a thermoelectric freezer and refrigerator.
* Flow Heat Transfer and Pressure Drop for Refrigerants with GWP < 150, DOE, 2019-2025
* Design and fabricate a flow condensation and boiling test bed.
* Test heat transfer and pressure drop of multiple low GWP refrigerants.
* InsulXtreme Steady-State R-Value Measurement, InsulXtreme, 2022-2023
* Design, make a budget, purchase materials, install, commission, and evaluate the test apparatus of the hot box.
* Install temperature sensors, power sensor, PID controller for the hot box.
* Use the validated hot box to test thermal performance (R-Value) of multiple specimens.
* Smart Operations of Common HVAC Systems, Turntide Technologies Inc., 2021-2022
* Develop, test, and implement FDD algorithms for 10 RTUs and 97 VRFs in the cloud-based building management platform.
* Install temperature, humidity, power, pressure sensors on an RTU system in the laboratory and connect them to the building management platform through BACnet IP protocol.
* Use python for the big data analysis for VRF systems and for implementing FDD.
* Electrical Signature Based Fault Detection and Classification Framework for Single-Speed, Unitary Heat Pumps, Electric Power Research Institute (EPRI), 2021.
* Design the testing plan and conduct the test in the psychrometric chamber.
* Collect the data through a data acquisition system and analyze the data through R software.
* Adaptive Neural Network Approach can achieve prediction rate of 96% for classifying faults.
* A Field Study to Characterize Fault Prevalence in Residential Comfort Systems, U.S. Department of Energy (DOE), 2019-2024
* Develop and validate a generic method used to find fault prevalence of five common installation faults in residential air conditioning systems in the US.
* Design, install, commission, and test two split systems with multiple faults imposed and use EES to model split systems.
* Fault interactions can have significant synergistic or canceling impacts and the superposition principle for modeling fault impact has up to 25% error.
* Simultaneous faults decrease capacity by up to 42% and COP by up to 39%.
* Investigation of Airside Fouling on Outdoor Heat Exchangers, Research Project 1705-RP, ASHRAE, 2015-2018
* Design, install, commission, and test of the test apparatus, install all the sensors, and use LABVIEW for the data collection.
* Investigate the important interactions of fouling and frost formation on a micro-channel heat exchanger in the psychrometric chamber.
* Light fouling increases heat transfer and frost formation; heavy fouling decreases these two parameters.
* 2012 International Solar Decathlon (Spain), U.S. Department of Energy (DOE), 2012
* Design, install, commission, test, and model HVAC system for the para-eco house.
* Participate in the competition with other 14 teams in Madrid.
* Win “thermal comfort” and “home function” third prize.
* China-US Clean Energy Joint Research Center Building Energy Conservation Cooperation Project-Research and Demonstration of New Energy and Renewable Energy Building Application Technology Adaptability, U.S-China Clean Energy Research Center (CERC), 2010-2012
* Conduct field tests and measurements of multiple ground source heat pump (GSHP) systems.
* Run the simulation using both EQEUST and TRNSYS software for GSHP systems.
* Improve system COP of the GSHP by 3.2-22.2% through different variable flow rate strategies.

## DESIGN AND ENERGY AUDIT PROJECTS

**HVAC and Fire Protection Design:**

* Design, calculate building loads, and commission multiple HVAC systems, including chiller plants, ground source heat pump systems, air source heat pump systems, variable refrigerant volume systems, and central heating systems.

[14] New Construction of Supporting Primary School in the 07-05 Plot of East Zhoupu Station of Metro Line 16 (Building area:21,000 m²), Zhoupu, Shanghai, China, 2017

[13] Xuzhou Pan'an Lake Science and Education Innovation Zone Start-up Area Project (Building area:136,000 m²), Xuzhou, Jiangsu, China, 2017

[12] Laboratory Building of Chemistry, Chemical Engineering & Resources, and Environment of Xinjiang University (Building area:57,000 m²), Urumqi, Xinjiang, China, 2017

[11] Protection and Repair of the Former Site of Nantong Tangzha Dasheng Textile Company (Building area:17,000 m²), Nantong, Jiangsu, China, 2016

[10] The 28th Research Institute of China Electronics Technology Group Corporation (Building area:177,000 m²), Nanjing, Jiangsu, China, 2016

[9] Yancheng Wanda Apartment (Building area:323,000 m²), Yancheng, Jiangsu, China, 2016

[8] Qingdao Citizens Fitness Center (Building area:60,000 m²), Qingdao, Shandong, China, 2016

[7] Hefei Technology College Hefei Campus (Building area:218,000 m²), Hefei, Anhui, China, 2015

[6] North China University of Water Resources and Electric Power New Campus (Building area:80,000 m²), Bengbu, Anhui, China, 2015

[5] Anhui Science and Technology University Phase Two (Building area:80,000 m²), Bengbu, Anhui, China, 2015

[4] Changzhou University Wujin Campus (Building area:47,000 m²), Changzhou, Jiangsu, China, 2015

[3] Yichang Municipal Party School (Building area:32,000 m²), Yichang, Hubei, China, 2015

[2] JiangSu HaiZhou Senior High School (Building area:12,000 m²), Lianyungang, Jiangsu, China, 2014

[1] Anhui Science and Technology University Phase One (Building area:96,000 m²), Bengbu, Anhui, China, 2014

**Energy Audit:**

* Implement energy audit measures through field measurements for multiple HVAC systems, including chiller plant and boiler heating systems, ground source heat pumps, air source heat pumps, air handling unit, fan coil terminals. Achieve 5-30% energy savings for all the energy audit projects.

[6] Design, Installation, And Commissioning of Two Residential Ground Source Heat Pump Systems in Jiading District, Shanghai, China, 2013-2014.

[5] Field Test of Ground Source Heat Pump System for Pujiang Zhigu in Minhang District, Shanghai, China, 2012-2013

[4] Test and Energy Audit of Chiller Plant with Ice Storage System for Shenzhen Bay Sports Center Stadium, China Resources (Holdings) Company Limited, Shenzhen, China, 2013

[3] Test and Energy Audit of Air Conditioning System in Ruian Plaza, Ruian Group, Shanghai, China, 2013

[2] Air Conditioning System Design of Net Zero Energy Building, Tongji University, Shanghai, China, 2012-2013

[1] Energy Saving Renovation of Wenyuan Building, Tongji University, Shanghai, China, 2012-2013

## JOURNAL PUBLICATIONS

* Published Papers

[J19] **Y. Hu**, B. Shen Development and field demonstration of residential air source integrated heat pump using a three-stage compressor. https://doi.org/10.1016/j.enbuild.2024.115202

[J18] **Y. Hu\*,** S.F. Yana Motta, C.M. Yang. Evaluation and development of flow condensation correlations using the data from low GWP refrigerants in an axial micro-fin aluminum tube, *Int. J. Refrig.*, 168 (2024): 454-468. https://doi.org/10.1016/j.ijrefrig.2024.09.016

[J17] **Y. Hu\***, B. Shen. Experimental insights into thermoelectric freezer systems: feasibility and efficiency. *Energy Convers. Manag.: X.*, 100676 (2024). https://doi.org/10.1016/j.ecmx.2024.100676

[J16] **Y. Hu**, B. Shen. A High Efficiency Rooftop Air Conditioning System Using Multi-speed Compressors. *Int. J. Refrig.*, 167 (2024): 1-12. https://doi.org/10.1016/j.ijrefrig.2024.07.024

[J15] **Y. Hu**, B. Shen, H. Wan, K.R. Gluesenkamp, S. Krishnamoorthy, D. Shirey. Heating performance of a vapor compression heat pump cascaded with a thermoelectric heat pump. *App. Therm. Eng.,* 249 (2024) 123397. https://doi.org/10.1016/j.applthermaleng.2024.123397

[J14] **Y. Hu\***, S.A. Jajja, C.M. Yang, S.F. Yana Motta, B.A. Fricke, K. Nawaz. In tube condensation of low global warming potential refrigerants in an axial micro-fin aluminum tube. *Int. J. Refrig.*,161 (2024): 221-241. https://doi.org/10.1016/j.ijrefrig.2024.03.001

[J13] **Y. Hu\***, Y. Zhang, X. Liu, H. Li, Y. Wang. A Virtual Supply Airflow Rate Sensor Based on Original Equipment Manufacturer Data for Rooftop Air Conditioners. J. Archit. Eng., 30 (1) (2024) 04023044. https://doi.org/10.1061/JAEIED.AEENG-1665

[J12]H. Shen, D.A. Hill, **Y. Hu**\*, M. Geng, X. Liu, H. Li. Model-Based Demand Control Ventilation for a Gun Range, J. Archit. Eng., 30 (1) (2024) 04023043. https://doi.org/10.1061/JAEIED.AEENG-1658

[J11]A. Ebrahimifakhar, M. Poursadegh, **Y. Hu**, D. P. Yuill, Y. Luo. A systematic review and meta-analysis of field studies of portable air cleaners: Performance, user behavior, and by-product emissions, *Sci. Total Environ.,* 912 (2024) 168786. https://doi.org/10.1016/j.scitotenv.2023.168786

[J10]Y., Chen, A. Ebrahimifakhar, **Y. Hu**, D. P. Yuill. Generalizability of machine learning-based fault classification for residential air-conditioners, *Energy and Build.,* 295 (2023) 113263. <https://doi.org/10.1016/j.enbuild.2023.113263>

[J9] **Y. Hu\***, Y. Zhang, X. Liu, H. Li. Development and demonstration of a method to detect refrigerant charge level for variable refrigerant volume systems. *App. Therm. Eng*., 235 (2023) 121354. https://doi.org/10.1016/j.applthermaleng.2023.121354

[J8] **Y. Hu\***, Y., Chen, D. P. Yuill. Experimental study of liquid line temperature drop as a fault feature for detecting severe liquid line restrictions in residential air conditioning systems. *Int. J. Refrig.*,152 (2023): 293-302. <https://doi.org/10.1016/j.ijrefrig.2023.04.029>

[J7] **Y. Hu\***, D. P. Yuill. Non-condensable gas in the refrigerant of air-source heat pumps: interactions between detection features, charge level, and temperature. *Int. J. Refrig.*,153 (2023): 378-384. https://doi.org/10.1016/j.ijrefrig.2022.10.006

[J6] **Y. Hu\*,** D. P. Yuill. Multiple simultaneous faults’ impacts air-conditioner behavior and performance of a charge diagnostic method, *App. Therm. Eng*., 215 (2022) 119015. <https://doi.org/10.1016/j.applthermaleng.2022.119015>

[J5] **Y. Hu\*,** D. P. Yuill. Impacts of common faults on an air conditioner with a microtube condenser and analysis of fault characteristic features, *Energy and Build.,* 254 (2022) 111630. <https://doi.org/10.1016/j.enbuild.2021.111630>

[J4] **Y. Hu\*,** D. P. Yuill. Effects of multiple simultaneous faults on characteristic fault detection features of a heat pump in cooling mode, *Energy and Build.,* 251 (2021) 111355. <https://doi.org/10.1016/j.enbuild.2021.111355>

[J3] **Y. Hu\*,** D. P. Yuill, S. A. Rooholghodos, A., Ebrahimifakhar, Y., Chen. Impacts of simultaneous operating faults on cooling performance of a high efficiency residential heat pump, *Energy and Build.,* 242 (2021) 110975. <https://doi.org/10.1016/j.enbuild.2021.110975>

[J2] **Y. Hu\***, D. P. Yuill, A. Ebrahimifakhar, and S.A. Rooholghodos. An experimental study of the behavior of a high efficiency residential heat pump in cooling mode with common installation faults imposed, *App. Therm. Eng.*, 182 (2020) 116116. <https://doi.org/10.1016/j.applthermaleng.2020.116116>

[J1] **Y. Hu\***, D. P. Yuill, and A. Ebrahimifakhar. The effects of outdoor air-side fouling on frost growth and heat transfer characteristics of a microchannel heat exchanger: an experimental study, *Int. J. Heat Mass Trans.*, 151 (2020) 119423. <https://doi.org/10.1016/j.ijheatmasstransfer.2020.119423>

* Submitted or In Preparation Papers

[JS1] **Y. Hu**, B. Shen. Development and evaluation of a multi-functional heat pump with wall embedded thermal storage. (under review)

[JS2] **Y. Hu**, B. Shen, K.R. Gluesenkamp, S. Krishnamoorthy, D. Shirey. Heating performance of an air source heat pump with a portable thermoelectric subcooler. (submitted)

## PATENT

H. Li and **Y. Hu**. Non-invasive Refrigerant Charge Fault Detection Method for VRF HVAC Systems (No. 2023-047). IP 63/683,375 (Filed). https://nutech.flintbox.com/technologies/84024b9a-f992-452f-9963-387dd22f7bbd.

B. Shen, **Y. Hu**, and K.R. Gluesenkamp. Thermoelectric Integrated Evaporator for Cooling at Two Distinct Temperatures and Energy Storage. Invention Disclosure ID# 202405783

L. Wang, K.R. Gluesenkamp, X. Liu, B. Shen, Z. Li, Y. Qiao, N. Kumar, **Y. Hu**. Controls For Operating Different Modes of TES-HP Systems. Invention Disclosure ID# 202405791

## CONFERENCE PUBLICATIONS

* Published Refereed Conference Papers

[C11] B. Shen, K.R. Gluesenkamp, **Y. Hu**, Z. Li, 2024.Residential Integrated Heat Pump to Meet All the Home Comfort Needs. ACEEE 2024 Summer Study on Energy Efficiency in Building, Aug 4 - 9, Pacific Grove, CA, USA. https://www.aceee.org/summer-study-2024-proceedings

[C10] B. Shen, K.R. Gluesenkamp, **Y. Hu**, B.A. Fricke, 2024. System Modeling of Frost/Defrost Cycles in Heat Pumps. *20th International Refrigeration and Air Conditioning Conference at Purdue*, Paper 2648, July 15-18, West Lafayette, IN, USA. https://docs.lib.purdue.edu/iracc/2648

[C9] **Y. Hu\***, S.F. Yana Motta, S.A. Jajja, C.M. Yang, B.A., Fricke, K. Nawaz, 2024. Experimental Study on Flow Condensation of Low Global Warming Potential Refrigerants in a Micro-fin Aluminum Tube. *20th International Refrigeration and Air Conditioning Conference at Purdue*, Paper 2563, July 15-18, West Lafayette, IN, USA. https://docs.lib.purdue.edu/iracc/2563

[C8] **Y. Hu\***, B. Shen, K.R. Gluesenkamp, S.F. Yana Motta, S. Krishnamoorthy. D. Shirey, 2024. Experimental Investigation on Heating Performance of a Cold Climate Thermoelectric-Assisted Heat Pump. *20th International Refrigeration and Air Conditioning Conference at Purdue*, Paper 2561, July 15-18, West Lafayette, IN, USA. https://docs.lib.purdue.edu/iracc/2561

[C7] **Y. Hu\***, B. Shen, K.R. Gluesenkamp, S.F. Yana Motta, 2024. Experimental Investigation on Cooling performance of A Thermoelectric Freezer. *20th International Refrigeration and Air Conditioning Conference at Purdue*, Paper 2560, July 15-18, West Lafayette, IN, USA. https://docs.lib.purdue.edu/iracc/2560

[C6] D.P. Yuill, A. Mammoli, T. Caudell, K. Gomatom, **Y. Hu**, O. Showunmi, 2022. Electrical Signature Based Fault Detection and Classification Framework for Single-Speed, Unitary Heat Pumps Using an Adaptative Neural Network Approach. *19th International Refrigeration and Air Conditioning Conference at Purdue,* Paper 2391, July 10-14, West Lafayette, IN, USA. <https://docs.lib.purdue.edu/iracc/2391>

[C5] **Y. Hu\***, D.P. Yuill, 2022. Comparison of multiple fault impacts on a heat pump and an air conditioner in cooling mode. *19th International Refrigeration and Air Conditioning Conference at Purdue,* Paper 2366, July 10-14, West Lafayette, IN, USA. <https://docs.lib.purdue.edu/iracc/2366>

[C4] **Y. Hu\***, D.P. Yuill, S.A. Rooholghodos, 2021. Interactions between Refrigerant Charge Level and Other Installation Faults on the Behavior of a Residential Heat Pump in Cooling Mode. *18th International Refrigeration and Air Conditioning Conference at Purdue*, Paper 2246, May 24-28, West Lafayette, IN, USA. <https://docs.lib.purdue.edu/iracc/2246>

[C3] **Y. Hu\***, D.P. Yuill, Y. Chen, 2021. Experimental Quantification of Liquid Line Temperature Drop as a Feature to Detect Liquid Line Restriction Faults in a Residential Heat Pump. *18th International Refrigeration and Air Conditioning Conference at Purdue*, Paper 2245, May 24-28,West Lafayette, IN, USA. <https://docs.lib.purdue.edu/iracc/2245>

[C2] **Y. Hu\***, D.P. Yuill, Y. Chen, 2021. Impacts and Detection of Non-Condensable Gas in a Residential Air Source Heat Pump. *18th International Refrigeration and Air Conditioning Conference at Purdue*, Paper 2244, May 24-28, West Lafayette, IN, USA. <https://docs.lib.purdue.edu/iracc/2244>

[C1] D.P. Yuill, **Y. Hu**, 2021. Investigation of Air-side Fouling of Split System Outdoor Heat Exchangers: Characterization, Performance Effects, and Frost Formation Interactions. *18th International Refrigeration and Air Conditioning Conference at Purdue*, Paper 2210, May 24-28, West Lafayette, IN, USA. https://docs.lib.purdue.edu/iracc/2110

## PRESENTATIONS

[12] **2024 Purdue Conference Presentation**, Experimental Study on Flow Condensation of Low Global Warming Potential Refrigerants in a Micro-fin Aluminum Tube. West Lafayette, IN, USA, July 15-18, 2024. https://docs.lib.purdue.edu/iracc/2563

[11] **2024 Purdue Conference Presentation**, Experimental Investigation on Heating Performance of a Cold Climate Thermoelectric-Assisted Heat Pump. West Lafayette, IN, USA, July 15-18, 2024. https://docs.lib.purdue.edu/iracc/2561

[10] **2024 Purdue Conference Presentation**, Experimental Investigation on Cooling performance of A Thermoelectric Freezer. West Lafayette, IN, USA, July 15-18, 2024. https://docs.lib.purdue.edu/iracc/2560

[9] **2022 Purdue Conference Presentation**, Comparison of multiple fault impacts on a heat pump and an air conditioner in cooling mode. West Lafayette, IN, USA, July 10-14, 2022. <https://docs.lib.purdue.edu/iracc/2366>

[8] **2021 Purdue Conference Presentation**, Interactions between Refrigerant Charge Level and Other Installation Faults on the Behavior of a Residential Heat Pump in Cooling Mode. West Lafayette, IN, USA (Virtual), May 24-28, 2021. <https://docs.lib.purdue.edu/iracc/2246>

[7] **2021 Purdue Conference Presentation**, Experimental Quantification of Liquid Line Temperature Drop as a Feature to Detect Liquid Line Restriction Faults in a Residential Heat Pump. West Lafayette, IN, USA (Virtual), May 24-28, 2021. <https://docs.lib.purdue.edu/iracc/2245>

[6] **2021 Purdue Conference Presentation**, Impacts and Detection of Non-Condensable Gas in a Residential Air Source Heat Pump. West Lafayette, IN, USA (Virtual), May 24-28, 2021. https://docs.lib.purdue.edu/iracc/2244

[5] **2021 ASHRAE Annual Conference Seminar Presentation**, Impacts of Faults on Unitary Air Conditioners. Austin, TX, USA (Virtual), June 28-30, 2021. https://store.accuristech.com/standards/seminar-43-fault-prevalence-types-and-impacts-by-building-types-and-system-types?product\_id=2238092

[4] **2020 NBERG Presentations**, Development and Demonstration of a Method to Quantify Fault Prevalence in Residential Air-Conditioning Systems, Omaha, NE, USA, September 7, 2020. https://engineering.unl.edu/NBERG/nberg-presentations

[3] **2020 ASHRAE Winter Conference Seminar Presentation**, How Does Fouling Affect Frost Formation and Heat Exchanger Performance on Residential Heat Pumps? Orlando, FL, USA, Feb. 1-6, 2020. https://store.accuristech.com/ashrae/standards/seminar-38-the-surprising-effects-of-outdoor-coil-fouling-on-heat-transfer-and-frost-formation-rate?product\_id=2122804

[2] **2019 NBERG Presentations**, Frost growth and heat transfer characteristics on a microchannel heat exchanger under clean and fouled surface conditions: an experimental study, Omaha, NE, USA, November 25, 2019. https://engineering.unl.edu/NBERG/nberg-presentations

[1] **Academic Exchange Presentation in Japan**, Case study of ground source heat pump in residential buildings in Shanghai, Osaka, Kyoto, and Tokyo, Japan, Aug. 18-23, 2013.

## PROFESSIONAL SOCIETIES AND SERVICE

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), member

**Reviewer for Journals and conferences:**

Nature Communications, 2024

Energy, 2024

Energy and Buildings, 2022, 2023, 2024, 2025

Applied Thermal Engineering, 2022, 2023, 2024

Journal of Building Engineering, 2023, 2024, 2025

Science and Technology for the Built Environment, 2022, 2023, 2024

ASCE Journal of Architectural Engineering, 2022, 2024

Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering, 2022

International Workshop on Materials Science and Mechanical Engineering, 2021

ASME Journal of Thermal Science and Engineering Applications, 2020

## HONORS AND AWARDS

2020-2021 **Milton E. Mohr** Fellowship, College of Engineering, University of Nebraska-Lincoln, Omaha, NE, USA. https://engineering.unl.edu/graduate-programs/graduate-student-awards/

2012-2013 **Kailan** Corporate Scholarship, Shanghai, China.

2012-2013 “**Outstanding Student**” of Tongji University, Shanghai, China.

2012 International Solar Decathlon, “**Thermal Comfort**” and “**Home Function**” third prize, Madrid, Spain. https://www.tongji.edu.cn/eng/info/1003/2671.htm

2011-2012 First place of “**Anyue Cup**” energy conservation and emission reduction, Shanghai, China

## LICENSES AND SKILLS

Professional Engineer: **PE Mechanical** (Nebraska: E-18211), Since June 2020. https://www.nebraska.gov/ea/search/search.php?page=details&lic=E18211

Professional Engineer: **PE Mechanical** (Tennessee:128766), Since June 2023.

https://search.cloud.commerce.tn.gov/search/C2475861/detail

Certification: **EPA 608 Universal** (1002735455330), Since March 2019. https://www.escogroup.org/student/default.aspx

Professional License: **Registered Utility Engineer (HVAC)** (SN00026293), Since September 2016 (China)

Professional Title: **HVAC Engineer** (020108), Since April 2017 (China)

Software: Python, R Language, MATLAB, EES, EQUEST, TRNSYS, MS Office, AutoCAD.