XIUQIANG HE

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APPOINTMENT

· **Postdoctoral Researcher** Nov., 2021 – Present
Automatic Control Laboratory (IfA), ETH Zürich, Switzerland
Advisor: Prof. Florian Dörfler

EDUCATION

· **Ph.D. in Control Science and Engineering** Aug., 2016 – Jun., 2021
Department of Automation, Tsinghua University, China
Dissertation: Research on Synchronization Issues in Power Systems with High Penetration of Power Electronics (link)
Advisor: Prof. Hua Geng

· **B.S. in Automation** Aug., 2012 – Jun., 2016
Department of Automation, Tsinghua University, China

RESEARCH INTERESTS

· Stability issues, particularly transient or large-disturbance stability, in future power systems

· Grid-forming control and dynamic ancillary services, e.g., dynamic virtual power plants

· Generic modeling of converter-interfaced generation for power system simulation studies

PUBLICATIONS

Topic I: Grid-Forming/-Following Control and Stability

[1] X. He, L. Huang, I. Subotić, V. Häberle, and F. Dörfler, "Quantitative stability conditions for grid-forming converters with complex droop control," 2023, https://arxiv.org/abs/2310.09933, submitted to *IEEE Trans. Power Electron.*.

[2] X. He and F. Dörfler, "Passivity and decentralized stability conditions for grid-forming converters," *IEEE Trans. Power Syst.*, pp. 1–4, 2024, https://doi.org/10.1109/TPWRS.2024.3360707.

[3] X. He, M. A. Desai, L. Huang, and F. Dörfler, "Grid-forming controls under grid faults: Hybrid forming, current limiting, and transient stability," 2023, working draft.

[4] M. A. Desai, X. He, L. Huang, and F. Dörfler, "Saturation-informed current-limiting control for grid-forming converters," 2023, accepted by *Electr. Power Syst. Res.* and patent pending.

[5] X. He, V. Häberle, I. Subotić, and F. Dörfler, "Nonlinear stability of complex droop control in converter-based power systems," *IEEE Control Syst. Lett.*, vol. 7, pp. 1327–1332, 2023, https://doi.org/10.1109/LCSYS.2023.3236276.

[6] X. He, V. Häberle, and F. Dörfler, "Complex-frequency synchronization of converter-based power systems," 2022, https://arxiv.org/abs/2208.13860, submitted to *IEEE Trans. Control Netw. Syst.*.

[7] H. Geng, C. He, Y. Liu, X. He, and M. Li, "Overview on transient synchronization stability of renewable-rich power systems," *High Voltage Engineering*, vol. 48, no. 9, pp. 3367–3383, 2022, https://doi.org/10.13336/j.1003-6520.hve.20221231. (In Chinese)

[8] C. He, X. He, H. Geng, H. Sun, and S. Xu, "Transient stability of low-inertia power systems with inverter-based generation," *IEEE Trans. Energy Convers.*, vol. 37, no. 4, pp. 2903–2912, 2022, https://doi.org/10.1109/TEC.2022.3185623. (Best Paper for the period 2021-2022)

[9] X. He, S. Pan, and H. Geng, "Transient stability of hybrid power systems dominated by different types of grid-forming devices," *IEEE Trans. Energy Convers.*, vol. 37, no. 2, pp. 868–879, 2022, https://doi.org/10.1109/TEC.2021.3113399.

[10] X. He, C. He, S. Pan, H. Geng, and F. Liu, "Synchronization instability of inverter-based generation during asymmetrical grid faults," *IEEE Trans. Power Syst.*, vol. 37, no. 2, pp. 1018–1031, 2022, https://doi.org/10.1109/TPWRS.2021.3098393.

[11] X. He and H. Geng, "PLL synchronization stability of grid-connected multiconverter systems," *IEEE Trans. Ind. Appl.*, vol. 58, no. 1, pp. 830–842, 2022, https://doi.org/10.1109/TIA.2021.3121262.

[12] X. He, H. Geng, J. Xi, and J. M. Guerrero, "Resynchronization analysis and improvement of grid-connected VSCs during grid faults," *IEEE J. Emerg. Sel. Top. Power Electron.*, vol. 9, no. 1, pp. 438–450, 2021, https://doi.org/10.1109/JESTPE.2019.2954555.

[13] X. He and H. Geng, "Transient stability of power systems integrated with inverter-based generation," *IEEE Trans. Power Syst.*, vol. 36, no. 1, pp. 553–556, 2021, https://doi.org/10.1109/TPWRS.2020.3033468.

[14] X. He, H. Geng, R. Li, and B. C. Pal, "Transient stability analysis and enhancement of renewable energy conversion system during LVRT," *IEEE Trans. Sustain. Energy*, vol. 11, no. 3, pp. 1612–1623, 2020, https://doi.org/10.1109/TSTE.2019.2932613.

[15] X. He, H. Geng, and S. Ma, "Transient stability analysis of grid-tied converters considering PLL's nonlinearity," *CPSS Trans. Power Electron. Appl.*, vol. 4, no. 1, pp. 40–49, 2019, https://doi.org/10.24295/CPSSTPEA.2019.00005.

[16] X. He, H. Geng, and G. Yang, "Reinvestigation of single-phase FLLs," *IEEE Access*, vol. 7, pp. 13 178–13 188, 2019, https://doi.org/10.1109/ACCESS.2019.2891973.

[17] X. He, H. Geng, and G. Yang, "A generalized design framework of notch filter based frequency-locked loop for three-phase grid voltage," *IEEE Trans. Ind. Electron.*, vol. 65, no. 9, pp. 7072–7084, 2018, https://doi.org/10.1109/TIE.2017.2784413.

[18] C. He, X. He, and H. Geng, "Transient stability of low-inertia power grid with inverter-based generations," in *The 10th Renewable Power Generation Conference (RPG 2021)*, vol. 2021, 2021, pp. 91–97, https://doi.org/10.1049/icp.2021.2284.

[19] J. Li, X. He, and H. Geng, "Grid code formulation recommendations on inverter-based generation during asymmetrical grid faults," in *The 10th Renewable Power Generation Conference (RPG 2021)*, vol. 2021, 2021, pp. 289–295, https://doi.org/10.1049/icp.2021.2285.

[20] X. He and H. Geng, "Synchronization stability analysis and enhancement of grid-tied multi-converter systems," in *2020 IEEE Industry Applications Society Annual Meeting*, 2020, pp. 1–8, https://doi.org/10.1109/IAS44978.2020.9334711.

[21] X. He, H. Geng, and G. Yang, "Synchronization stability analysis of grid-tied power converters under severe grid voltage sags," in *2018 IEEE International Power Electronics and Application Conference and Exposition (PEAC)*, 2018, pp. 1–6, https://doi.org/10.1109/PEAC.2018.8590280. (Excellent Paper Award)

Topic II: IBR-Based Dynamic Ancillary Services

[22] V. Häberle, X. He, L. Huang, E. Prieto-Araujo, and F. Dörfler, "Optimal dynamic ancillary services provision based on local power grid perception," 2023, submitted to *IEEE Trans. Power Syst.*.

[23] R. Domingo-Enrich, X. He, V. Häberle, E. Prieto-Araujo, and F. Dörfler, "Dynamic complex frequency control of grid-forming converters," 2023, working draft.

[24] V. Häberle, L. Huang, X. He, E. Prieto-Araujo, and F. Dörfler, "Dynamic ancillary services: From grid codes to transfer function-based converter control," 2023, https://arxiv.org/abs/2310.01552, accepted by *Electr. Power Syst. Res.*.

[25] V. Häberle, L. Huang, X. He, R. S. Smith, and F. Dörfler, "MIMO grid impedance identification of three-phase power systems: Parametric vs. nonparametric approaches," in *Proc. 62nd IEEE Conference on Decision and Control*, 2023, https://doi.org/10.1109/CDC49753.2023.10383646.

[26] V. Häberle, A. Tayyebi, X. He, E. Prieto-Araujo, and F. Dörfler, "Grid-forming and spatially distributed control design of dynamic virtual power plants," *IEEE Trans. Smart Grid*, 2023, https://doi.org/10.1109/TSG.2023.3311481, in press.

[27] C. Feng, L. Huang, X. He, Y. Wang, F. Dörfler, and Q. Chen, "Joint oscillation damping and inertia provision service for converter-interfaced generation," 2023, https://arxiv.org/abs/2309.01321.

[28] J. Xi, H. Geng, and X. He, "Adaptive VSG control scheme for large scale wind farms to improve frequency response characteristics," in *2019 IEEE Industry Applications Society Annual Meeting*, 2019, pp. 1–7, https://doi.org/10.1109/IAS.2019.8912376.

Topic III: Modeling of Renewable Energy Generation

[29] X. He, H. Geng, and G. Mu, "Modeling of wind turbine generators for power system stability studies: A review," *Renew. Sust. Energ. Rev.*, vol. 143, p. 110865, 2021, https://doi.org/10.1016/j.rser.2021.110865.

[30] X. Jiao, X. He, H. Geng, and B. Ren, "Hybrid average-value modelling of DFIG-based wind energy conversion systems," in *The 10th Renewable Power Generation Conference (RPG 2021)*, vol. 2021, 2021, pp. 193–198, https://doi.org/10.1049/icp.2021.2369.

[31] X. He, H. Geng, and G. Yang, "Mode clustering based dynamic equivalent modeling of wind farm for small-signal stability analysis," 2021, https://arxiv.org/abs/2109.08383.

[32] X. He, H. Geng, and G. Yang, "Dynamic equivalent modeling of wind power plants for various timescale small signal stability analyses," in *2019 IEEE Power and Energy Society General Meeting (PESGM)*, 2019, pp. 1–5, https://doi.org/10.1109/PESGM40551.2019.8974059.

[33] X. He and H. Geng, "An overview on wind farm modelling for power system stability studies," in *8th Renewable Power Generation Conference (RPG 2019)*, 2019, pp. 1–8, https://doi.org/10.1049/cp.2019.0676.

[34] X. He, H. Geng, G. Yang, X. Zou, and Y. Li, "Equivalent modelling of wind farm for small-signal stability analysis in weak power system," *J. Eng.*, vol. 2017, no. 13, pp. 1388–1393, 2017, https://doi.org/10.1049/joe.2017.0559.

Topic IV: HVDC Integration of Renewable Energy Generation

[35] S. Zhao, X. He, C. Lv, Y. Zhou, S. Xu, X. Liu, and H. Geng, "Black start-up and coordinated control strategy of standalone doubly-fed wind farms connected to LCC-HVDC," *Power System and Clean Energy*, vol. 37, no. 7, pp. 87–96,135, 2021, https://doi.org/10.3969/j.issn.1674-3814.2021.07.012. (In Chinese)

[36] X. He, G. Hua, Y. Geng, and Z. Xin, "Startup and integration control strategy of DFIG based isolated wind farm connected with LCC-HVDC," *Autom. of Elec. PowerSyst*, vol. 43, no. 9, pp. 99–107, 2019, https://doi.org/10.7500/AEPS20180125006. (In Chinese)

[37] X. He, H. Geng, G. Yang, and X. Zou, "Coordinated control for large-scale wind farms with LCC-HVDC integration," *Energies*, vol. 11, no. 9, 2018, https://doi.org/10.3390/en11092207.

[38] X. He, H. Geng, G. Yang, and X. Zou, "VSG control for DFIG-based islanded wind farm with LCC-HVDC integration," in *2018 IEEE Power and Energy Society General Meeting (PESGM)*, 2018, pp. 1–5, https://doi.org/10.1109/PESGM.2018.8585982.

RESEARCH EXPERIENCE

- **AGISTIN project:** Advanced Grid Interfaces for innovative STorage INtegration (AGISTIN), https://www.agistin.eu/
  (Supported by the European Union's Horizon 2020) Jan. 2023 – Present

  Main Participant

  Investigate Task 3.5 (Development of optimization and control methods for real-time AGI operation) in WP 3.

- **POSYTYF project:** POwering SYstem flexibiliTY in the Future (POSYTYF) through Renewable Energy Sources https://posytyf-h2020.eu/
  (Supported by the European Union's Horizon 2020) Nov. 2021 – Present

  Main Participant

  Investigate Task 4.2 (Novel stability and assessment in future power systems) in WP 4.

- **IEC TS 63406 ED1: Generic RMS Simulation Models of Converter-Based Generating Units for Power System Dynamic Analysis** link to the IEC Website
  (Led by IEC SC 8A) Apr. 2018 – Present

  Member, Technical Secretary of the IEC SC 8A WG 8

  Worked with the convener Prof. Hua GENG, accomplished a modeling evaluation task and prepared a technical report to review the existing generic modeling for converter-based generation by IEC, WECC, CIGRE, IEEE, and CEPRI, and also identify the gaps remaining in the standardized modeling. A technical specification (IEC TS 63406 ED1) is being developed to address converter-based generating unit generic models.

- **Equivalence and Simulation Modeling of Large-Capacity Wind Farms** *(Supported by the State Grid)* Jun. 2016 – Dec. 2019

  Main Participant

  Conducted the EMT simulation modeling of wind turbines, PV generation systems, SVC, STATCOM in PSCAD/EMTDC and also the equivalent aggregated modeling of wind farms. The models were used in the transient response analysis of the sending-end system of China Jiu-Hu ±800 kV HVDC and Qing-Yu ±800 kV HVDC projects.

- **Flexible Grid-Connection Control and Application of Wind Power Generation Systems** *(Supported by the NSFC)* Jan. 2018 – Dec. 2020

  Main Participant

  Proposed a generalized framework of frequency-locked loop (FLL) synchronization approaches; Proposed a grid-connection control strategy for isolated wind farms with LCC-HVDC integration. The proposed strategy was considered as a potential scheme for 100% renewables integrated with the Qing-Yu HVDC.

- **Large-Disturbance Stability and Cascading Failure Evolution in Power Systems with High Penetration of Power Electronics** *(Supported by the NSFC)* Jan. 2021 – Present

  Main Participant

Conducted transient synchronization stability modeling, analysis, and control for grid-connected converters and for hybrid power systems with converters and generators.

- **Multi-Device Joint Real-Time Simulation Platform and Power Hardware-in-the-Loop Experimental Platform** Jun. 2020 – Present

  Main Contributor

  Involved in the design and establishment of a real-time simulation platform (composed of RT-LAB, Typhoon HIL, and dSPACE) and the design of a power hardware-in-the-loop experiment platform.

STUDENT SUPERVISION

- **Master Project: Complex frequency control of dynamic virtual power plants**, Roger Domingo-Enrich, co-supervised with Verena Häberle, Spring 2023.
- **Semester Project: Aggregated modeling of grid-forming converters with complex droop control**, Martin Pedersen, co-supervised with Verena Häberle, Spring 2023.
- **Semester Project: Stable current-limiting control for grid-forming converters**, Maitraya Avadhut Desai, co-supervised with Linbin Huang, Fall 2022.

TEACHING EXPERIENCE

- **Control Systems** (Prof. Florian Dörfler), Teaching Assistant (Fall Semester 2022, Spring Semester 2023, Fall Semester 2023, Spring Semester 2024), ETH Zurich.
- **Control Systems I** (Prof. Florian Dörfler), Teaching Assistant (Spring Semester 2022), ETH Zurich.
- **Fundamentals of Analog Electronics Technology** (Prof. Hua GENG), Teaching Assistant (for three semesters), Tsinghua University.
- **Electric Drive and Motion Control** (Prof. Geng YANG), Teaching Assistant (for two semesters), Tsinghua University.

TALKS

- *Stability guarantees for grid-forming complex droop control*, talk at the Third Champéry Power Conference, Feb. 2024, Champéry, Switzerland.
- *Multivariable grid-forming control and nonlinear stability analysis*, invited talk at the 9th Workshop of Power Electronics Emerging Technologies, Oct. 2023, Nanjing, remote talk.
- *Multivariable stability of converter-based power systems: centralized and decentralized methods*, IFA coffee talk, Apr. 2023, ETH Zurich.
- *Complex-frequency synchronization and multivariable stability analysis*, invited session talk in 2022 4th International Conference on Smart Power & Internet Energy Systems (SPIES 2022), Dec. 2022, remote.
- *Transient stability of power electronics-dominated power networks: principle and application*, tutorial of the 47th Annual Conference of the IEEE Industrial Electronics Society (IECON 2021), remote.
- *Synchronization stability analysis and enhancement of grid-tied multi-converter systems*, in 2020 IAS Annual Meeting, Oct. 2020, remote.
- *Transient stability analysis and enhancement of renewable energy conversion system during LVRT*, in PESGM 2020, Aug. 2020, remote.
- *Modeling of inverter-based generation for power system stability studies*, in IEC SC 8A ahG 3 Meeting, Oct. 2019, Nanjing, China.

· *Modeling recommendation of wind turbine/farm for power system stability studies*, in PESGM 2019, Aug. 2019, Atlanta, USA.

· *Hardware-in-loop tools for power engineering education*, in PESGM 2019 (on behalf of Prof. GENG), Aug. 2019, Atlanta, USA.

· *Dynamic equivalent modeling of wind power plants for various timescale small signal stability analyses*, in PESGM 2019, Aug. 2019, Atlanta, USA.

· *Synchronization stability analysis of grid-tied power converters under severe grid voltage sags*, in IEEE PEAC 2018, Nov. 2018, Shenzhen, China. (Best Presenter Award)

ACADEMIC SERVICES

· **Member, Technical Secretary**, IEC SC 8A WG 8 *Modeling of Renewable Energy Generation for Power System Dynamic Analysis*

· **Invited Session Chair**, the 10th International Conference on Renewable Power Generation (RPG 2021)

· **Reviewer**, IEEE TPWRS, TSTE, TSG, TEC, TPWRD, TIE, TII, TPEL, TIA, JESTPE, JETCAS, and Automatica, etc.

SELECTED AWARDS

· **First Prize of Science and Technology Progress Award of China Power Supply Society**
Awarded by the China Power Supply Society Nov. 2023

· **Outstanding Doctoral Dissertation (Nomination) of China Power Supply Society**
Awarded by the China Power Supply Society Apr. 2023

· **Star Reviewer of IEEE Transactions on Energy Conversion**
Awarded by the IEEE Transactions on Energy Conversion Editorial Broad Dec. 2021

· **Tsinghua University Outstanding Doctoral Dissertation**
Top 10%, awarded by Tsinghua University Jun. 2021

· **Beijing Outstanding Graduates**
Top 5%, awarded by the Beijing Ministry of Education Jun. 2021

· **China National Scholarship**
Awarded by the Chinese Ministry of Education Dec. 2019

· **Outstanding Reviewer of IEEE Transactions on Sustainable Energy**
Awarded by the IEEE Transactions on Sustainable Energy Editorial Broad Feb. 2019

· **The Second Prize, the First Beijing's Universities AI Academic Forum Award**
Awarded by the Beijing's Universities AI Academic Forum Committee Mar. 2019

· **The First Class Fellowship of Tsinghua University Graduate Student Professional Practice**
Awarded by the Graduate School of Tsinghua University Dec. 2018

· **China National Scholarship**
Awarded by the Chinese Ministry of Education Nov. 2018

· **IEEE PEAC Conference Excellent Paper**
Awarded by the IEEE PEAC Committee Nov. 2018

· **IEEE PEAC Conference Best Presenter**
Awarded by the IEEE PEAC Committee Nov. 2018

· **The 22nd CPSS Annual Conference Excellent Paper**
Awarded by the China Power Supply Society Nov. 2017

· **The 22nd CPSS Annual Conference Best Presenter**
Awarded by the China Power Supply Society Nov. 2017

· **The Third Prize, Tsinghua University Student Laboratory Construction Award**
Awarded by the Laboratory and Equipment Department, Tsinghua University Mar. 2017

· **Tsinghua University Academic Scholarship**
Awarded by Tsinghua University Oct. 2014

· **HAGE Scholarship**
Awarded by the Department of Automation, Tsinghua University Oct. 2014

MEMBERSHIP

· Member, IEEE Power and Energy Society

· Member, China Power Supply Society

SKILLS

· **Simulation Tools:** MATLAB/Simulink, PSCAD/EMTDC, RT-LAB, Typhoon HIL, dSPACE

· **Programming Languages:** C/C++, C#, MATLAB, LaTeX

Updated in February. 2024.