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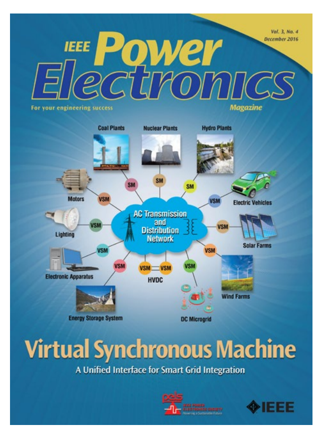
Highlights

- IEEE Fellow (2017 Class), IET Fellow (2010 Class).
- The Synchronized-and-Democratized (SYNDEM) architecture and the Virtual Synchronous Machines (VSM) technologies he invented for power systems were **cited in the U.S. Congress Hearing on "The Electric Grid of The Future"** in 2018 [M8].
- "Q.-C. Zhong and G. Weiss, Synchronverters: Inverters That Mimic Synchronous Generators" published in *IEEE Transactions on Industrial Electronics* in April 2011, **Google citations: 3416**, is a **Top 3 Most-cited Non-survey Paper in the journal's 43-year history** out of all 19,790 papers published by the journal, according to the data on March 12, 2025.
- "Q.-C. Zhong, Virtual Synchronous Machines: A unified interface for grid integration" published in *IEEE Power Electronics Magazine* in December 2016 as a **cover story** is recognized as the **Most Popular Technical Article and a Highly-Cited Paper in the Magazine's 10-year history** by this market-leading professional Magazine, Feb. 2025.
- **Semi-plenary speaker at 2017 World Congress** of International Federation of Automatic Control (IFAC), **the world's largest conference** in systems & control engineering with 3500+ attendees.
- Research featured by IEEE Power Electronics Magazine as a cover story, by IEEE Spectrum as a "vision for a harmonious grid", by Canary Media as a "Game Changer for Grid", and included by IEEE PES Task Force report as Path to the Future, reached city, county and state officials via American City&County and policy-makers & utilities via IEEE Smart Grid and Institute of Public Utilities [M30].
- **Distinguished Lecturer of three IEEE societies**: Control Systems Society (CSS, 2015-2018), Power Electronics Society (PELS, 2014-2017), Power and Energy Society (PES, 2016-2020).
- **Associate Editor of four IEEE Transactions**: *IEEE Transactions on Automatic Control*; *IEEE Transactions on Control Systems Technology*; *IEEE Transactions on Industrial Electronics*; *IEEE Transactions on Power Electronics*.
- One PhD student received the Control and Automation Doctoral Dissertation Award, Institute of Engineering and Technology (IET), UK and two PhD students received the Chinese National Award for Outstanding Students Abroad including one Grand Prize (only 10 around the world each year).
- **Four research monographs**, including Q.-C. Zhong, *Power Electronics-Enabled Autonomous Power Systems: Next Generation Smart Grids*, Wiley-IEEE Press, 2020, a **Top-3 Best Power Systems Book for Beginners** by BookAuthority.org, the world's leading site for book recommendations.
- **Delivered 26 plenary/keynote talks** and 200+ invited lectures in 20+ countries.
- **Working Group Chair, IEEE Standard 2988-2024** *Recommended Practice for Use and Functions of Virtual Synchronous Machines*, 2021 - 2024.
- **Founded startup Syndem LLC and commercialized two products**:
    - *Smart Grid Research and Educational Kit*, a reconfigurable and reprogrammable all-in-one power electronic converter, to **educate next-generation engineers. Sold to 10+ countries**.
    - *9kW Virtual Synchronous Machines*. Sold to 2 countries.

Semi-plenary talk at the 2017 IFAC World Congress, the world's largest systems and control conference



Education

2001.6-2003.12	Ph.D.	Dept. of Electrical & Electronic Engineering, Imperial College London, UK
1997.4-1999.12	Ph.D.	Dept. of Automation, Shanghai Jiao Tong University, China
1994.9-1997.4	M.Sc.	Dept. of Electrical Engineering, Hunan University, China
1985.9-1990.7	B.Eng.	Dept. of Electrical Engineering, Hunan Institute of Engineering, China

Current and Previous Positions

Date	Employer	Position
2014.8-now	Dept. of Electrical and Computer Engineering, Illinois Institute of Technology, Chicago, USA	Max McGraw Endowed Chair Professor of Energy and Power Engineering
2017.5-now	Syndem LLC, Greater Chicago, USA	Founder & CEO
2012.4-2016.9	Dept. of Automatic Control and Systems Eng., Univ. of Sheffield, UK	Chair Professor then Research Professor after 2014.9
2012.8-2013.4	Center for Power Electronics Systems, Virginia Tech, Blacksburg, USA	Visiting Professor
2012.2-2014.12	China Electric Power Research Institute (CEPRI), Beijing, China	Consultant
2012.1-2012.8	Dept. of Mechanical and Aerospace Eng., Univ. of California, San Diego, USA	Visiting Scholar
2010.8-2012.4	Dept. of Aeronautical and Automotive Engineering, Loughborough Univ., UK	Chair Professor
2005.8-2010.8	Dept. of Electrical Engineering and Electronics, Univ. of Liverpool, UK	Senior Lecturer
2004.1-2005.7	School of Electronics, University of Glamorgan, UK	Senior Lecturer, then Reader
2001.4-2003.12	Dept. of Electrical and Electronic Engineering, Imperial College London, UK	Postdoctoral Fellow
2000.2-2001.4	Faculty of Mechanical Engineering, Technion-Israel Institute of Technology, Israel	Postdoctoral Fellow
1998.7-1999.9	Dept. of Automation, Shanghai Jiao Tong Univ., China	Research Assistant
1995.9-1996.2	Dept. of Electrical Engineering, Hunan University, China	Research Assistant
1990.7-1994.9	Dept. of Electrical Engineering , Xiangtan Institute of Mech. and Elec. Tech., China	Assistant Lecturer

Strategic Career Advancements

He has successfully made six strategic advancements in his career:

- **From Hardware to Hardware & Software.** He began his professional career in 1990 as a hardware engineer, working on motor drives, power electronics, PLCs, and embedded systems circuits with microcomputers (Intel, Atmel, Motorola, Zilog). His role evolved to integrate software, starting with studying, line-by-line, the operating system of an embedded system written in assembly language. Later, he developed 100KB objective codes using assembly language for a 16-reactor chemical production line (1992), 10,000-line codes using C language for a flexible manufacturing system (1995), and a web-based database using PowerBuilder (1997). This hardware-software integration was mostly practice-oriented and laid a strong foundation for his future career.
- **From Practice to Practice & Theory.** In 1997, he shifted from purely practical work to integrating theoretical research, beginning with chemical process control and later on robust control theory. Through extensive study, including tracing mathematical literature back to the 1930s, he solved several fundamental H_∞ control problems of delay systems. This led to his 1st research monograph, *Robust Control of Time-delay Systems* (2006). His 2nd monograph, *Control of Integral Processes with Dead Time* (2010, co-authored with A. Visioli), further solidified his key role in control engineering.
- **From Control to Control & Power Electronics.** In 2001, upon relocating to the UK, he expanded his focus on control to include power electronics. He developed many enabling control technologies for power electronic converters and invented several novel hardware converter topologies. This led to his 3rd research monograph, *Control of Power Inverters in Renewable Energy and Smart Grid Integration* (2013, Wiley-IEEE Press), co-authored with his former PhD student Tomas Hornik.
- **From Control & Power Electronics to Control, Power Electronics, and Power Systems.** While working on control and power electronics, he identified many challenges in future power systems and naturally expanded his research into power systems. In 2008, he invented the synchronverter technology (and coined the English word "synchronverter") to operate power converters as virtual synchronous machines (VSM). This earned him a Leverhulme Trust Senior Research Fellowship from Royal Academy of Engineering, UK, in 2009 to advance the technology. He later invented a control strategy to achieve synchronization without using any phase-locked loop, which had been considered essential for grid-tied converters. The deeper he advanced the research, the more questions popped up. He realized that the problem was not merely technical but systemic - requiring some fundamental thinking at the systems level rather than just at the engineering level.
- **From Engineering to Systems Science.** He decided to look for solutions from systems science. After thinking for many years and reading books and papers on large-scale natural, engineered, and societal systems, he eventually merged the widely-studied synchronization principles in natural sciences with the well-established democracy concepts in social sciences to create the holistic SYNDEM (meaning Synchronized-and-Democratized) architecture. This harmonizes and unifies the integration and interaction of distributed energy sources and flexible loads, with power converters controlled as VSM. Hence, the synchronization mechanism of synchronous machines, which has underpinned the operation and expansion of power systems for over 100 years, can continue to be used to govern future power systems. This solves the compatibility and scalability problems faced by future power systems. Moreover, it circumvents the limitations of democratized societies as characterized by Nobel Laureate Kenneth Arrow's Impossibility Theorem, ensuring a synchronized consensus for stability as he has recently proven mathematically using the port-Hamiltonian theory. This led to his 4th research monograph, *Power Electronics-Enabled Autonomous Power Systems: Next Generation Smart Grids* (2020, Wiley-IEEE Press).
- **From Research and Education to Entrepreneurship - Closing the Theory-Practice Cycle.** Recognizing the profound societal impact of the SYNDEM architecture and VSM technologies, he took on a new challenge and founded Syndem LLC to commercialize these innovations. He delivered 26 plenary and keynote talks, alongside 200+ invited talks, in 20+ countries to promote global adoption of the technologies and foster the market. Moreover, he led the development of international standards on VSM and created Smart Grid Research and Educational Kits to help educate next-generation engineers, addressing the global shortage of a qualified workforce. Syndem LLC also secured 4 federal grants, sold 2 products globally, and generated over $1.5M sales revenues.

Summary of Major Contributions

Google Scholar Citations: 19,232; **h-index**: 62; **i10-index**: 163 (March 23, 2025)

He is a multidisciplinary researcher and engineer specializing in systems and control, power electronics, and power systems, a pioneering theorist shaping fundamental systems concepts, and a visionary entrepreneur driving ground-breaking innovations across academia, industry, and technology. Some of his major contributions are listed below.

Systems Science

Synchronized-and-Democratized (SYNDEM) Architecture

He merged the widely-studied synchronization principles in natural sciences with the well-established democracy concepts in social sciences to form the SYNDEM architecture for large-scale systems, and applied it to address the systemic challenges faced by future power systems with distributed energy players [M35], [124], [B1], [33]. This circumvents the limitations of democratized societies characterized by Nobel laureate and economist Kenneth Arrow's Impossibility Theorem[1], enabling autonomous power systems with enhanced grid stability and reliability. This holistic architecture solves the compatibility and scalability problems faced by the paradigm shift of power systems from electric machines-based to power electronics-based, enabling autonomous operation of future power systems and advancing energy freedom and energy equity. As written in his research monograph [B1], "future power systems will not only be democratized but also should be synchronized. This leads to the concept of Synchronized-and-Democratized (in short, SYNDEM) smart grids. … The synchronization mechanism of synchronous machines, which has underpinned the organic growth and stable operation of power systems for over 100 years, can continue serving as the Rule of Law for SYNDEM smart grids. Moreover, the power electronic converters that are adopted to integrate different players can be equipped with the synchronization mechanism through control to achieve Legal Equality. … The synchronization phenomenon has intrigued some of the most brilliant minds of the 20th century, including Albert Einstein, Richard Feynman, and Norbert Wiener. In 2017, the Nobel Prize in Physiology/Medicine was awarded to Jeffrey C. Hall, Michael Rosbash and Michael W. Young for their discoveries of molecular mechanisms that synchronize cellular metabolism and organismal behavior to the light-dark cycle to generate biological rhythms with 24 h periodicity. Hence, adopting the synchronization mechanism of synchronous machines as the Rule of Law to govern SYNDEM smart grids is probably also the most natural option." His research monograph [B1] "*offers a technical solution to implement the lateral power envisioned by futurist Jeremy Rifkin that underpins the Third Industrial Revolution,*" written by Keith Schneider, a *New York Times* correspondent since 1982. Michael Pesin, Deputy Assistant Secretary at U.S. Department of Energy (DOE) invited him to visit the DOE Headquarters and commented, "*Sooner or later, this will be deployed worldwide.*" He was recognized by the International Federation of Automatic Control (IFAC) as a semi-plenary speaker [124] at the 2017 IFAC World Congress, the world's largest systems and control conference (nicknamed "*the Olympics in Control*") with 3500+ participants. He was appointed as a Distinguished Lecturer of three IEEE societies (Power Electronics Society, Control Systems Society, and Power and Energy Society) to deliver lectures on this worldwide. His research monograph [B1] is recognized as a *Top-3 Best Power Systems Book for Beginners by BookAuthority.org*[2], the world's leading site for book recommendations. The SYNDEM architecture and VSM technologies were **cited in the U.S. Congress Hearing on "The Electric Grid of the Future"** in 2018 [M8], and reported by Canary Media in 2017 as a "Game Changer for Grid" [M13], by SmartGridNews.com as "a self-directed smart grid" [M17], by IEEE Spectrum in 2013 as "Completely Self-Controlled Power Systems" for "systems in which there could be millions of active players" [M18] and in 2017 as a "vision for a harmonious grid" [M12], by IIT Magazine as "*Tao of Power*" [M11], and included by IEEE PES Task Force report as Path to the Future, reached city, county and state officials via American City&County [M33] and utilities & policy-makers via IEEE Smart Grid [M35] and Institute of Public Utilities [M30]. He was interviewed by Science News Radio Network in 2014 [M16].

[1] Arrow's Impossibility Theorem says that, when there are more than two distinct candidates, there does not exist a voting (democratic) system that can convert individual preferences about the candidates into a transitive, i.e. strictly ranked, order of community preferences if four fairness criteria, which are perfectly reasonable when considered separately, are required at the same time.

[2] BookAuthority.org, The Best Power Systems Books for Beginners, https://bookauthority.org/books/beginner-power-systems-books?t=1yj0cz&s=award&book=1118803523.

Ghost Power Theory

The concepts of real power and reactive power play a vital role in various physical domains. The physical meaning of real power is clear: it represents the power (energy) that does the real work. However, the physical meaning of reactive power is not clear – it is an imaginary mathematical concept. He introduced the ghost operator to physically construct the ghost of a sinusoidal signal, by adding $\pi/2$ radians to the phase, and further the ghost of a system with sinusoidal inputs by adding the ghost operator to the inputs [31], [B1]. With the concept of the ghost system, the reactive power of a system is the real power of the ghost system with its input being the ghost of the input to the original system. For an electrical machine, the real power is related to the electromagnetic *torque* T but no similar quantity is defined to associate with the reactive power. In order to close this gap, he coined the term *quorte* Γ as the dual of torque, representing the ratio of the reactive power to the flux [B1], [5], [122]. Since no reactive power concept was defined for mechanical systems, he then introduced reactive power for mechanical systems, placing the last piece to complete the analogy between electrical systems and mechanical systems. Furthermore, he generalized this to any dynamic system that can be described by a port-Hamiltonian (PH) system model, establishing a significantly simplified instantaneous power theory, referred to as the ghost power theory. This theory is applicable across multiple physical domains with multiple frequencies (harmonics) and multiple phases. It has been adopted by several researchers to improve the performance of motor drives and is expected to be applied to other domains as well because of its fundamentality.

Algebraic Riccati Equation, Similarity Transformation and Block Diagrams

He uncovered the hidden connection between the well-known Algebraic Riccati Equations (ARE) and the widely-used block diagrams, through the well-known mathematical tool of similarity transformations [203], [B4]. This linkage not only facilitates solving ARE but also provides deeper insights into the structure of ARE and establishes the equivalence of multiple ARE derived from different H_∞ control methods.

J-spectral Factorization and Similarity Transformation

He proved [91], [205] that the *J*-spectral factorization of a general regular para-Hermitian transfer matrix is equivalent to the existence of a common nonsingular matrix that similarly transform the *A*-matrices of both the transfer matrix and its inverse into 2x2 lower and upper triangular block matrices with the (1, 1)-block capturing all the stable modes of the transfer matrix and its inverse, respectively.

Power Electronics and Power Systems

Synchronverters and Virtual Synchronous Machines (VSM)

He invented the synchronverter technology in 2008 to operate power electronic converters according to the mathematical model of conventional synchronous generators with embedded inertia and damping [79], [196], [P16], and then applied it to integrate wind turbines [67], [170], PV panels [152], STATCOM [172], rectifiers [173], and motor drives [188], [189] etc. The seminal paper [79] published in *IEEE Transactions on Industrial Electronics* is a ***Top 3 Most-cited Non-survey Paper in the journal's 43-year history***, with 3400+ Google citations and 35,000+ views. The technology is recognized as "game changer for grid" [M13], receiving the IET Innovation Award in 2009. The cover story "Virtual Synchronous Machines – A unified interface for smart grid integration" [40] *published in the market-leading professional journal, IEEE Power Electronics Magazine, in 2016 is The* ***Most Popular Technical Article and a Highly-Cited Paper in the Magazine's 10-year history***. It outlines how power electronic converters, either on the supply side or on the load side, can all be controlled to behave like virtual synchronous machines (VSM) with the inherent dynamics of synchronous machines, *providing a unified interface for seamless smart grid integration with virtual damping and inertia* to facilitate large-scale utilization of distributed energy resources and enhance grid stability and reliability. *Thirteen years after the invention of the synchronverter technology and five years after the cover story on VSM*, the U.S. Department of Energy (DOE) Solar Energy Technologies Office (SETO) funded the $25-million Universal Interoperability for Grid-Forming Inverters (UNIFI) Consortium in 2021 to "develop a *universal* set of guidelines that enable *seamless* integration of inverter-based resources"[3]. *Another five years later,* the U.S. DOE Advanced Research Projects Agency-Energy (ARPA-E) announced the $30-million Grid Reliability with *Automatic Damping and Inertia* for Electrical Networks and Transmission Systems (GRADIENTS) program in 2025 to "help incorporate a variety of generation sources and stabilize the grid to prevent cascading failures that can lead to dangerous and costly blackouts" and "to enable better grid coordination, protection, and

[3] DOE, UNIFI Consortium, https://www.energy.gov/eere/solar/unifi-consortium.

real-time control, resulting in a more reliable, more resilient American energy landscape." [4] *These landmark federal initiatives highlight the lasting impact and critical needs of the VSM technologies.*

Passivity and Input-to-State Stability of Large-Scale Power Systems Enabled by VSM
He developed a VSM-based control framework to render a power electronic system passive by adopting the port-Hamiltonian (pH) systems theory [5], [122]. *This theory combines the Hamiltonian modeling approach in geometric mechanics (a mathematics branch) and the port-based network modeling approach widely used in different physical domains (mechanical, electrical, hydraulic, thermal, etc.) to represent a system as a network of interconnected components. The dynamics of each component are described through a Hamiltonian function and the interactions between the components are governed by a Dirac structure that enforces energy conservation at the system level*. In a follow-on paper in 2024 [2], he generalized this mathematical control framework to model generic power systems dominated by power converters that are interconnected through a passive transmission and distribution (T&D) grid. This framework is scalable, applicable to power systems having an arbitrary number of power converters with passive controllers, passive loads, and different types of passive T&D lines connected in a meshed configuration without self-loops, and hence it is very generic. Moreover, the resulting power system is mathematically proven to be passive and input-to-state stable, ensuring a synchronized consensus for stability of SYNDEM smart grids. The LinkedIn post on this quickly received 27,000+ views.

Self-synchronization Without Using any Phased-Locked Loop
He proposed, for the first time, to achieve synchronization for inverters through control without using any phase-locked loop (PLL) [69], improving control performance and stability while reducing complexity and computational burden. This defines a new norm for industry practice as the current industry has been relying on PLL for synchronization, although there are many known drawbacks. The self-synchronization paper [69] received 1,200+ Google citations with 15,000+ views.

Robust Droop Control and Universal Droop Control
He identified and corrected three fundamental flaws of the conventional droop control when applied to power converters, ensuring proportional sharing of real power and reactive power while achieving specified voltage and frequency regulation [181], [74], regardless of the impedance value, parameter mismatch of components, and numerical errors. Later, he mathematically proved the robust droop controller to be universal for converters with different impedance types as well [162], [56], paving the way for mass manufacturing of power converters. Moreover, he established the structural resemblance among droop-controlled converters, VSMs and PLL [48], [163], laying a solid mathematical foundation to achieve self-synchronization without using any PLL [69], [45], and to qualify the robust (universal) droop controlled converters with any physically-implementable impedance as the second-generation VSM [33], [B1]. The robust droop control paper [74] received 1,000+ Google citations with 11,000+ views.

Power Quality Control
He identified and analyzed the mechanisms that could cause the degradation of converter power quality and proposed a series of control strategies to mitigate power quality degradation, including shaping the converter impedance to be capacitive at low frequencies [68], [179], adopting an unusual cascaded current-voltage control structure [73], injecting harmonic voltage components through a novel harmonic droop controller [75], adopting the H_∞ repetitive controller [78], [82], [97], adopting the UDE-based controller equipped with time-delayed filters [15], [21], bypassing harmonic current components to shape the impedance [171] etc. The power quality control is an important part of his book [B2], which once ranked No. 7 on Amazon's Best Sellers list for Power Generation & Distribution.

Power Electronic Converters with a Common DC and AC Ground
Ground is one of the most fundamental concepts in electrical engineering. The importance of a common ground is well recognized in the telecom industry, with the governing standard ANSI/TIA-607. However, this has not been recognized in the power industry. Along with the large-scale deployment of power converters at high voltages, high currents, and high switching frequencies, this fundamental problem will gradually emerge and cause electro-magnetic interference (EMI) and leakage-current problems, because the DC ground and the AC ground of the power converters deployed nowadays are mostly separated. In

[4] ARPA-E Announces $30 Million to Increase Grid Resiliency Under Dynamic Conditions, https://arpa-e.energy.gov/news-and-events/news-and-insights/arpa-e-announces-30-million-increase-grid-resiliency-under-dynamic-conditions.

order to prevent this from happening, he proactively invented several novel converter topologies with a common DC and AC ground, including an independently-controlled neutral leg [B2], [27], the θ-converter [42], [36], the Beijing converter [39], and the Syndem converters [P1], [P4], together with the necessary control strategies. These technologies are commercialized by his start-up company in products, which enables grounded operation without using an isolation transformer for enhanced safety, the sharing of a common storage among multiple converters for reduced costs, significant reduction of leakage currents for lowered fire risks, and fast and accurate detection of ground faults for enhanced protection and safety. These technologies will be extremely important when wide-bandgap semiconductor devices are widely used for applications with high voltages, high currents, and high switching frequencies, which is imminent.

Current-limiting Controller

Power electronic converters can easily be damaged due to over-currents so it is essential to ensure converter currents stay below a given bound. He developed current-limiting control methods for DC/DC converters [20], single-phase rectifiers [52], and three-phase rectifiers [26], current-limiting droop control for grid-tied inverters [32], and current-limiting controller without using a PLL [50]. He for the first time demonstrated that it was possible to ride through short-circuit faults on the AC side [50].

Impedance-Sum Stability Criteria

The small-signal stability of power converters is very important. He proved that the stability of single converter/source is equivalent to its impedance without any right-half-plane (RHP) zeros or RHP poles. He also proved that a system with two individually stable converters/sources is stable if and only if the sum of the individual impedances does not have any RHP zeros [19]. This impedance-sum stability criteria can be applied regardless of the connection of the two converters/sources, whether in parallel operation, such as parallel-operated voltage-controlled inverters in microgrids and parallel-operated current-controlled inverters connected to the grid, or in series (cascaded) operation, such as cascaded DC/DC converters and grid-connected current-controlled converters.

Impedance Shaping for Enhanced Stability and Performance

Impedance determines the stability and behavior of a system. He introduced control strategies to change the impedance of normal converters from inductive to resistive [74] and capacitive [68], termed as R-converters and C-converters, respectively, to shape the converter impedance for enhanced power quality [171], virtual damping [B1], [P5], and stability [18], [43], [44], [51], [57], [59].

Control Theory

Robust Control of Time-delay Systems

He systematically and comprehensively studied robust H_∞ control of time-delay systems in the frequency domain using the state-space approach and solved several fundamental problems [B4], such as *J*-spectral factorization [91], controller parameterization [98], the delay-type Nehari problem [101], the extended Nehari problem [100], the standard H_∞ control problem for systems with a single delay [100], and an open problem related to the implementation of distributed delays in control laws [95], [92], [206], [210]. The standard H_∞ control problem of systems with a single input/output delay is transformed into a delay-free standard H_∞ control problem and a one-block problem with the delay, which is subsequently converted to an extended Nehari problem [100], using the chain-scattering approach. All the control laws incorporate a modified Smith predictor, of which a numerical issue is identified. To address this, a unified Smith predictor [211], [94] is proposed. Finally, the implementation of distributed delays in control laws is explored with three methods: using discrete delays [95] and rational functions obtained with the δ-operator [92] and the bilinear transformation [206]. This leads to two formulas that significantly enhance the accuracy of conventional rectangular numerical integration methods [B4].

UDE (Uncertainty and Disturbance Estimator)-based Robust Control Theory

He introduced the UDE (uncertainty and disturbance estimator)-based robust control theory for systems subject to uncertainties and external disturbances [93]. Based on the fact that any engineering signal has a finite frequency spectrum, he proposed a method for lumping uncertainties and disturbances within a system, passing them through a filter, and feeding the filtered output back into the system to compensate for these uncertainties and disturbances. Through a series of subsequent papers to address two-degree-of-freedom structure [77], asymptotic reference and disturbance rejection [34], output feedback control [12], stabilization [16], mismatched uncertainties and disturbances [6], [22], input constraints [9], etc., he established the UDE-based robust control theory, transforming complex robust control problems into straightforward filter design problems. Today, this theory is widely adopted across diverse applications, including time-delay systems [80], [81], [28], unmanned aerial vehicles [24], [53], power electronic converters [15], [21], [29], [30], wind turbines [37], piezoelectric stages [49], servo systems [60], wing rock motion stabilization [62], and chemical processes [46], [22], etc.

Bounded Integral Controller for Guaranteed Closed-loop Stability

Feedback is one of the most fundamental concepts in control systems and engineering. However, the feedback mechanism cannot guarantee the stability of a closed-loop system even if the plant is open-loop stable. He introduced the bounded integral controller (BIC) [41] to guarantee the closed-loop system stability in the sense of boundedness for input-to-state (practically) stable (ISpS) plant systems, which holds for most engineering systems, by generating a bounded controller output independently from the plant parameters and states. He further designed the BIC parameters to ensure that the controller output stays within a given bound, extending the result for locally ISpS plant systems. The BIC can replace the traditional integral controller and guarantee asymptotic stability of the desired equilibrium point under certain conditions, thus solving the closed-loop stability problem of many engineering systems that are locally ISpS without requiring knowledge of the plant structure or parameters. This has been applied to bounded universal droop control [4], controller with limited control power [8], systems with input constraints [9], VSM with bounded frequency and voltage [25], bounded droop controller [66], etc.

Standards Development

He led a working group to develop IEEE Standard 2988-2024 - *IEEE Recommended Practice for Use and Functions of Virtual Synchronous Machines* (VSM) from ideation to publication, completed nine months ahead of the schedule with a 97% approval rate. This is the first global standard on VSM, uniting contributions from key manufacturers, such as GE, Siemens, Hitachi, Toshiba-Mitsubishi, ABB, Eaton, Schneider Electric, S&C Electric, SEL, and major utilities, such as North American Electric Reliability Corporation (NERC), Electric Reliability Council of Texas (ERCOT), Midcontinent Independent System Operator (MISO), Southern California Edison, and National Grid. It is expected to play a pivotal role in facilitating the large-scale utilization of distributed energy resources and the integration of power converters to the grid, and advancing energy freedom and energy access.

Science Education and Public Engagement

In addition to conventional teaching, education, and mentoring activities, he published four research monographs; offered three courses directly from his research, served as a Distinguished Lecturer of three IEEE societies; delivered 26 plenary/keynote lectures and 200+ invited talks in 20+ countries; organized 19 workshops and tutorial sessions; conducted radio interviews; and engaged with the public through LinkedIn posts, press releases, and articles. He developed Smart Grid Research and Educational Kits (and sold to 10 countries) to educate next generation engineers. He published educational papers [10], [1] to encourage professors around the world to Go Real and equip students with hands-on skills. He also helped build up world-class large-scale facilities for research and education [M4]. He organized the 2015 IEEE International Future Energy Challenge, an annual undergraduate student competition, with the topic on VSM for battery systems. Twelve teams from six countries took part in the competition and 80+ people, mostly students, participated in the follow-on workshop.

Policy Shaping

The SYNDEM architecture and VSM technologies **were cited in the U.S. Congress hearing** on “The Electric Grid of the Future” in 2018 [M8]. He was **invited to deliver a talk to the U.S. Department of Energy** in 2021 on Next-generation Smart Grids: Autonomous Power Systems. "*Sooner or later, this will be deployed worldwide*," said Michael Pesin, Deputy Assistant Secretary at U.S. Department of Energy. In 2019, he **organized an NSF-funded Workshop on Power Electronics-enabled Operation of Power Systems** to raise the awareness of funding agencies and policy-makers to support research and education in the area, attracting 130+ participants from agencies, regulatory commissions, utilities, think-tanks, vendors, and universities. Moreover, he **published articles in *American City & County*** [M33], targeting U.S. city, county and state officials who are charged with developing and implementing government policy, programs and projects, and **in *Impact*** [M34], targeting the wider global public sector, funders and policy makers to influence future decisions. He also engaged with **IEEE Smart Grid**, serving on the Steering Committee, and delivered a Distinguished Lecture to the **Institute Of Public Utilities’ Grid School**, which is designed to improve regulatory capacity for grid-related policy development and decision-making at all government levels. As a member, he contributed to the UK Energy System Operator VSM Expert Group, leading to the UK Grid Code change GC0137.

Media Coverage

[M1]. Syndem LLC is recognized as a **Top Key Players in Smart Energy Market**, https://www.prophecymarketinsights.com/market_insight/smart-energy-market-5750, Jan. 2025.

[M2]. Innovation intelligence firm StartUs Insights, with instant access to 4.7M+ startups, features Syndem as a **Top 3 Power Electronics Startup** Out Of 123 In Grid Modernization, Dec. 2024, https://www.startus-insights.com/innovators-guide/3-top-power-electronics-startups-out-of-123/.

[M3]. Syndem LLC is recognized as one of **8 Best Smart Grid Companies to Watch in 2025** by ClimateSort.com, https://climatesort.com/smart-grid-companies/, December 2024.

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Public Engagement

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[M20]. LinkedIn post on generic control and modelling framework for power systems, January 9, 2024, ~**28,000** impressions, https://www.linkedin.com/feed/update/urn:li:share:7150486664505643010.

[M21]. LinkedIn post on Smart Grid Research and Educational Kits, ~**20,000** impressions, Sep 20, 2023, https://www.linkedin.com/feed/update/urn:li:share:7110255406605627392.

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[M23]. Syndem LLC, Wiley-IEEE Publish Syndem CEO's Book on Power Electronics-Enabled Autonomous Power Systems: Next Generation Smart Grids, EIN Presswire, https://www.einpresswire.com/article/517763787 , 9-Jun-21, Picked up by about **270 websites**. The LinkedIn post on this received over 10,000 impressions.

[M24]. Syndem LLC, Syndem Founder and CEO Dr. Zhong to lead IEEE Standards Working Group on Virtual Synchronous Machines (VSM), EIN Presswire, https://lnkd.in/epKdC-F, 6-Apr-21, Picked up by **101 websites**. The LinkedIn post on this received 6500 impressions.

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[M26]. Syndem LLC, Syndem to Provide Grid-forming Solar and Storage Inverters for a Project Selected by the U.S. Department of Energy, EIN Presswire, https://lnkd.in/erPyd6h, 21-Dec-20, Picked up by **552 websites**.

[M27]. Syndem LLC, IEEE TV Releases Syndem CEO's Keynote at IECON 2020 on Next-Generation Smart Grids, EIN Presswire, https://www.einpresswire.com/article/532495732, 10-Dec-20, Picked up by 84 websites.

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[M30]. Distinguished Lecture, Power Electronics-Enabled Autonomous Power Systems: Synchronized-and-Democratized (SYNDEM) Smart Grids, **Institute Of Public Utilities (IPU) Grid School**, East Lansing, Michigan, April 9-12, 2018.

[M31]. Distinguished Lecture, Synchronization and Democratization of Future Power Systems, **Summer Institute on Sustainability and Energy (SISE)**, Chicago, 2017.

[M32]. Qing-Chang Zhong, Primary Frequency Control of Future Power Systems, *IEEE Smart Grid Newsletter*, June 2017, available at https://dyh28w2y3a9av.cloudfront.net/video/private/SGNL0243/SGNL0243.pdf.

[M33]. Qing-Chang Zhong, Rethinking Renewable Power Systems, *American City&County*, pp.10-14, March 2020, available at https://secure.viewer.zmags.com/publication/1c544127#/1c544127/12.

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Awards and Honors

- "Q.-C. Zhong and G. Weiss, Synchronverters: Inverters That Mimic Synchronous Generators" published in *IEEE Transactions on Industrial Electronics* in April 2011, **Google citations: 3416**, is a **Top 3 Most-cited Non-survey Paper in the journal's 43-year of history** *out of all 19,790 papers published by this leading journal*, according to the data on March 12, 2025.
- "Q.-C. Zhong, Virtual Synchronous Machines: A unified interface for grid integration" published in *IEEE Power Electronics Magazine* in December 2016 as a **cover story** is recognized as the **Most Popular Technical Article and a Highly-Cited Paper in the Magazine's 10-year history** and the Top Paper of 2016 published by this market-leading professional Magazine, Feb. 2025.
- The Synchronized-and-Democratized (SYNDEM) architecture and enabling Virtual Synchronous Machines (VSM) technologies he invented for power systems were **cited in the U.S. Congress hearing** on "THE ELECTRIC GRID OF THE FUTURE" in 2018 [M8].
- Semi-plenary Speaker, 2017 World Congress of the International Federation of Automatic Control (**the world's largest conference in systems/control engineering** with 3500+ participants), France, 2017.
- Fellow, IEEE (Institute of Electrical and Electronics Engineers, USA), 2017.
- Fellow, IET (Institution of Engineering and Technology, UK), 2010.
- Distinguished Lecturer:
    - IEEE Power Electronics Society (PELS, 2014-2017)
    - IEEE Control Systems Society (CSS, 2015-2018)
    - IEEE Power and Energy Society (PES, 2016-2020)
- Innovation Award for synchronverters, Institute of Engineering and Technology (IET), UK, 2009
- Senior Research Fellow, Royal Academy of Engineering/Leverhulme Trust, UK, 2009-2010
- Best Doctoral Thesis (the Eryl Cadwaladar Davies Prize), Imperial College London, UK, 2004
- Outstanding Reviewer for *Automatica*, 2004
- Awards to Supervised Students and Postdocs:
    - Postdoc Mohammad Amin, IEEE IES Students and Young Professionals Paper Assistance (SYPA) Competition Award, 2018.
    - PhD student Wenlong Ming, IET Control & Automation PhD Award, UK, 2017.
    - PhD student Xin Zhang, Chinese National Award for Outstanding Students Abroad, Grand Prize (10 awards around the world each year), 2016.
    - PhD student Wenlong Ming, Chinese National Award for Outstanding Chinese Students Abroad by the China Scholarship Council (500 awards around the world each year), 2015.
    - MEng student Tomas Hornik, IET Prize, 2007
- Selected recognitions to his startup company Syndem LLC founded in 2017
    - 2018: Finalist for Exelon's Climate Change Investment Initiative (2c2i).
    - 2019: Semifinalist for $1M 76west Competition, which is "one of the largest" competitions in U.S. that focuses on supporting entrepreneurs to build clean-energy businesses and economic development, by New York State Energy Research and Development Authority (NYSERDA).
    - 2024: Top 3 Power Electronics Startups Out of 123 In Grid Modernization by Innovation intelligence firm StartUs Insights [M2].
    - 2024: 8 Best Smart Grid Companies to Watch in 2025 by ClimateSort.com [M3].
    - 2025: Top Key Players in Smart Energy Market, prophecymarketinsights.com [M1].

Plenary and Keynote Talks

1. Keynote talk, Power-Electronics-Enabled Autonomous Power Systems: Next-Generation Smart Grids, at the *Workshop on Powering the Future: Mastering Grid-Forming Inverters in Renewable Energy Systems*, Doha, Qatar, December 4-5, 2024.
2. Keynote talk, Power-Electronics-Enabled Autonomous Power Systems: Next-Generation Smart Grids, at the *IEEE Workshop on Smart Converters for Sustainable Energy Systems*, Stockholm, Sweden, December 2, 2024.
3. Plenary talk, Power-Electronics-Enabled Autonomous Power Systems: Next-Generation Smart Grids, at the *2023 Panda Forum on Power and Energy*, Chengdu, China, April 27-30, 2023.
4. Keynote talk, Power Electronics-Enabled Autonomous Power Systems: Next Generation Smart Grids, *IEEE Int. Conf. on Electrical Engineering & Sustainable Technologies*, Lahore, Pakistan, Dec. 2022.
5. Keynote talk, Power Electronics-Enabled Autonomous Power Systems: Next Generation Smart Grids, at *the 46th Annual Conference of the IEEE Industrial Electronics Society (IECON 2020)*, Singapore, October 18-21, 2020.
6. Keynote talk, Synchronized-and-Democratized Smart Grids - Next Generation Smart Grids, the *24th International Conference on Electrical Engineering (ICEE 2018)*, Seoul, South Korea, June, 2018
7. Semi-plenary talk, Autonomous Distributed Control of Next-Generation Smart Grids, at *The 2017 Asian Control Conference*, Gold Coast, Australia, December 2017.
8. Keynote talk, Next-Generation Smart Grids: Architecture and Technical Route, at *The 2017 Southern Power Electronics Conference*, Puerto Varas, Chile, December 2017.
9. Plenary talk, Autonomous Distributed Control of The Next-Generation Smart Grid, at *The XIII National Conference - Control in Power Electronics and Electric Drives*, Lodz, Poland, November 2017.
10. Semi-plenary talk, Synchronized-and-Democratized Smart Grids (SYNDEM), at *The 20th World Congress of the International Federation of Automatic Control (IFAC)*, Toulouse, France, July 2017.
11. Opening Keynote, Next-Generation Smart Grids: Power Eletronis-enabled Autonomous Power Systems, *the Digital Energy Summit at NIWeek 2017*, Austin, Texas, May 22-25, 2017.
12. Keynote talk, Next-Generation Smart Grids: Power Eletronis-enabled Autonomous Power Systems, at the First IEEE Workshop on Smart Grids - UFSM, The Federal University of Santa Maria (UFSM), Brazil, September 26, 2016.
13. Keynote talk, The Democratization of Power Systems: Architecture and Technical Route, at the *Digital Utilities Europe 2016 Conference*, London, UK, May 2016.
14. Keynote talk, Next-Generation Smart Grids: Architecture and Technical Routes, at *Global Energy Interconnection Forum*, Chicago IL, Nov. 2015.
15. Keynote talk, Next-Generation Smart Grids: Architecture and Technical Routes, *the 5th International Conference on Power Engineering, Energy and Electrical Drives*, Riga, Latvia, May 11-13, 2015.
16. Plenary talk, Distributed Control of Next-Generation Smart Grids with Many Players, at the *1st Indian Systems and Controls Conference*, Chennai, India, Jan. 5-7, 2015.
17. Keynote talk, Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), *20th Int. Conference on Automation and Computing (ICAC2014)*, Cranfield, UK, Sept. 12-13, 2014.
18. Keynote talk, Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), at *Real-Time 2014 Conference*, Montreal, Canada, June 9-12, 2014.
19. Distinguished Lecture, Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), *26th Chinese Control and Decision Conference (CCDC)*, Changsha, China, May 31, 2014.

20. Plenary talk, Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), at *Delta Power Electronics Forum*, Suzhou, China, May 30, 2014.
21. Keynote talk, Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), at *2014 IEEE International Energy Conference*, Croatia, May 13-16, 2014.
22. Plenary talk, Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), the *8th Symposium on Power Electronics and Electrical Drives (SPEED)*, Wuhan, China, April 11-13, 2014.
23. Plenary talk, Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), at the *6th IEEE Annual Green Technologies Conference* in Corpus Christi, Texas, April 3-4, 2014.
24. Plenary talk, Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), at the *3rd Int. Conference on Advances in Control and Optimization of Dynamical Systems (ACODS)*, IIT Kanpur, India, March 13-15, 2014.
25. Plenary talk, Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), at *the 29th Annual Conference of Chinese Universities on Electric Power Systems and Automation*, Yichang, China, Nov. 7-10, 2013.
26. Plenary talk, Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), at *the 4th IEEE Conference on Power Electronics for Distributed Generation Systems (PEDG)* in Rogers, Arkansas, July 8 – 11, 2013. *The first plenary talk*.

Workshops, Tutorials and Panel Discussions

1. Moderator, Panel on Large-scale Utilization of Distributed Energy Resources in D.C.: Challenges and Solutions, IEEE PES General Meeting, Washington D.C., July 2021.
2. Tutorial on Grid-forming Inverters, Virtual Synchronous Machines, and Power Electronics-enabled Autonomous Power Systems, IEEE Energy Conversion Congress & Expo, Detroit, MI, Oct. 2020
3. NSF Workshop on Power Electronics-enabled Operation of Power Systems, Chicago, Oct. 31, 2019.
4. Panel on *The University at the Energy Barricades* at The Empowering Communities and Cities, Chicago, IL, November 2017.
5. Panel on *Primary Frequency Response,* the 2017 IEEE PES General Meeting, Chicago, IL, July 2017.
6. Panel on *Synchronous Control of Power Converters for Renewable Applications and Beyond* at the 2017 IEEE PES General Meeting, Chicago, IL, July 2017.
7. Tutorial on *Next-Generation Smart Grids: Architecture and Technical Routes* at the 2016 IEEE International Symposium on Industrial Electronics, Santa Clara CA, June 2016.
8. Panel Discussion on *Power Electronics-enabled Autonomous Power Systems* at the 2016 IEEE PES General Meeting, Boston, MA, July 2016.
9. Tutorial on *Virtual Synchronous Machines for Power Electronics based Power Systems and Microgrids* at 2015 IEEE Energy Conversion Congress & Exposition (ECCE 2015), Montreal, Canada, September 20, 2015.
10. Workshop on *Next Generation Smart Grids: Power Electronics Based Power Systems* at the 2015 American Control Conference, Chicago, IL, June 30, 2015.
11. International Future Energy Challenge (Topic B), Sheffield, UK, July 20-22, 2015.
12. Tutorial on *Power Electronics based Power Systems: Next Generation Smart Grids* at the 40th Annual Conference of the IEEE Industrial Electronics (IECON), Dallas, TX, Oct. 29-Nov. 1, 2014.
13. Tutorial on *Control of Power Inverters for the Smart Grid*, at the 19th IFAC World Congress, Cape Town, South Africa, August 24-29, 2014.

14. Tutorial on *Control of Power Inverters for Smart Grids*, at the 5th International Symposium on Power Electronics for Distributed Generation Systems (PEDG2014), Galway, Ireland, June 24-27, 2014.
15. Tutorial on *Control of Power Inverters for the Smart Grid*, at the 2014 American Control Conference, Portland, OR, June 4 - 6, 2014.
16. Workshop on *Control of Power Inverters for the Smart Grid* at the 2013 American Control Conference, Washington, DC, June 16, 2013.
17. *Next-Generation Smart Grid: Completely Autonomous Power Systems (CAPS)*, 2013 CPES Annual Conference, Center of Power Electronics, Virginia Tech, April 7, 2013, **the first presentation on the grid architecture.**
18. Workshop on *Control of Power Inverters in Renewable Energy and Smart Grid Integration*, CPES, Virginia Tech, March 9, 2013.
19. Workshop on *Control and Power Electronics for Renewable Energy and Smart Grid Integration* at the 51st IEEE Conference on Decision and Control, Hawaii, Dec., 2012.
20. Tutorial on *Control of Power Inverters for Renewable Energy and Smart Grid Integration,* at the 38th Annual Conference of the IEEE Industrial Electronics, Montreal, Canada, October 27, 2012, which was the most welcomed tutorial at the conference with all 100 seats reserved well before the closure of online registration.
21. Workshop on *Control of Power Inverters for Renewable Energy and Distributed Generation*, at the 2012 American Control Conference, Montréal, Canada, June 26, 2012.

Selected Invited Talks

200+ invited talks at universities, institutions and companies around the world. Some are listed below.

1. Invited talk for the inauguration of the Guwahati Subsection of the IEEE Industry Applications Society (IAS) Chapter Power-Electronics-Enabled Autonomous Power Systems: Next-Generation Smart Grids, India, October 16, 2024.
2. Distinguished lecture on Power-Electronics-Enabled Autonomous Power Systems: Next-Generation Smart Grids, organized by IEEE Austin - PES, IAS, PELS & IES Joint Chapter, June 22, 2021.
3. Invited talk, Next-generation Smart Grids: Autonomous Power Systems, **Department of Energy**, U.S., March 31, 2021. **Well attended and well received by DOE policy makers and influential leaders, including Dr. Dan Mote Jr., former President of the National Academy of Engineering**.
4. Invited talk, SYNDEM Technology to Emulate Synchronous Machines, webinar organized by Midcontinent Independent System Operator (MISO), March 11, 2021.
5. IEEE CSS Distinguished lecture on Autonomous Distributed Control of the Next-Generation Smart Grid, Guayaquil, Ecuador, November 13, 2019.
6. IEEE PES Distinguished lecture on Next-Generation Smart Grids: Synchronized-and-Democratized (SYNDEM) Smart Grids, Binghamton University, October 17, 2019.
7. Power Electronics-enabled Autonomous Power Systems: Synchronized-and-Democratized (SYNDEM) Smart Grids, NSF Workshop on Power Electronics-enabled Operation of Power Systems, Chicago, October 31-November 1, 2019.
8. Distinguished lecture on Next-Generation Smart Grids: Synchronized-and-Democratized (SYNDEM) Smart Grids, organized by IEEE Rockford Chapter, September 19, 2019.
9. Distinguished lecture on Next-Generation Smart Grids: Synchronized-and-Democratized (SYNDEM) Smart Grids, organized by IEEE PES Dallas Chapter, July 16, 2019.
10. IEEE PELS Webinar on Synchronized-and-Democratized Smart Grids, March 20, 2018.
11. IEEE PELS Distinguished Lecture on Synchronized-and-Democratized Smart Grids: Next-Generation Smart Grids, Santiago, Chile on Dec. 1, 2017.

12. IEEE CSS Distinguished Lecture, Autonomous Distributed Control of The Next-Generation Smart Grid, Warsaw University of Technology, Poland, November 23, 2017.
13. IEEE CSS Distinguished Lecture on Autonomous Distributed Control of Next-Generation Smart Grid for the IEEE Rocky Valley section, Rockford, IL, Nov 16, 2017.
14. IEEE PELS/CSS/PES Distinguished Lecture on Synchronized-and-Democratized Smart Grids: Next-Generation Smart Grids, Illinois Institute of Technology, November 3, 2017.
15. IEEE PELS Distinguished Lecture on Synchronized-and-Democratized Smart Grids: Next-Generation Smart Grids, Grand Rapids, Western Michigan, Oct 18, 2017.
16. IEEE PELS Distinguished Lecture on Enabling Technologies in Control and Power Electronics for Power and Energy Systems, Montreal, Canada, Oct 10, 2017.
17. IEEE CSS Distinguished Lecture on Autonomous Distributed Control of Next-Generation Smart Grid, for the IEEE Coulee Subsection, La Crosse WI, Sept 19, 2017.
18. IEEE CSS Distinguished Lecture on Autonomous Distributed Control of Next-Generation Smart Grid, for the IEEE Southern Minnesota Section, Rochester MN, Sept 18, 2017.
19. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Power Electronics-Enabled Autonomous Power Systems, ERCOT, Austin, August 23, 2017.
20. Virtual Synchronous Machine and Autonomous Power Systems, Southwest Jiaotong University (SWJTU), May 5, 2017.
21. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Power Electronics-Enabled Autonomous Power Systems, Pittsburgh, PA, April 25, 2017.
22. Virtual Synchronous Machine and Autonomous Power Systems, China Electric Power Research Institute (CEPRI), Beijing, China, March 21, 2017.
23. Virtual Synchronous Machine and Autonomous Power Systems, Hunan Institute of Engineering (HNIE), Xiangtan, China, March 18, 2017.
24. IEEE PES Distinguished Lecture on Next-Generation Smart Grids: Power Electronics-Enabled Autonomous Power Systems, IEEE PES Chicago Chapter, March 8, 2017.
25. IEEE PELS Distinguished Lecture on Next-Generation Smart Grid: Power Electronics-Enabled Autonomous Power Systems, Sao Paulo, Brazil, September 30, 2016.
26. IEEE PELS Distinguished Lecture on Next-Generation Smart Grid: Power Electronics-Enabled Autonomous Power Systems, Santa Maria, Brazil, September 24, 2016.
27. Next-Generation Smart Grid: Control Architecture and Technical Route, Oak Ridge National Laboratory (ORNL), September 06, 2016.
28. Next-Generation Smart Grid: Control Architecture and Technical Route, Pacific Northwest National Laboratory (PNNL), August 29, 2016.
29. IEEE CSS Distinguished Lecture on Autonomous Distributed Control of The Next-Generation Smart Grid, Universidad de Piura, Peru, August 1, 2016.
30. Virtual Synchronous Machine and Autonomous Power Systems, State Grid Corporation of China (SGCC) - Sichuan, Chengdu, China, June 2, 2016.
31. Virtual Synchronous Machine and Autonomous Power Systems, State Grid Corporation of China (SGCC) - Jiangsu, China, May 26, 2016.
32. IEEE CSS Distinguished Lecture on Autonomous Distributed Control of the Next-Generation Smart Grid, Peru, August 3, 2016.
33. Bounded Control that Preserves System Stability and its Applications, University of Cambridge, Cambridge, UK, May 10, 2016.
34. Virtual Synchronous Machine and Autonomous Power Systems, Goldwind, March 17, 2016.
35. Virtual Synchronous Machine and Autonomous Power Systems, China Electric Power Research Institute (CEPRI), Beijing, China, March 18, 2016.
36. IEEE PELS & CSS Distinguished Lecture on Next-Generation Smart Grids: Power Electronics-based Autonomous Power Systems, Aalborg University, December 22, 2015.

37. Next-Generation Smart Grids: Architecture and Technical Route, Argonne National Laboratory (ANL), November 12, 2015.
38. IEEE PELS & CSS Distinguished Lecture on Next-Generation Smart Grids: Power Electronics-Enabled Autonomous Power Systems, Atlanta, November 23, 2015.
39. Grid of the Future: Control Architecture, University of Illinois Chicago, October 6, 2015.
40. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), Smart Grid Institute, August 10, 2015.
41. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), Harbin Institute of Technology, August 5, 2015.
42. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), Wasion Group, Changsha, China, August 2, 2015.
43. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), Hunan Institute of Engineering (HNIE), December 31, 2014.
44. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), Zhejiang University, December 30, 2014.
45. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), Shanghai Jiao Tong University (SJTU), December 29, 2014.
46. IEEE PELS Distinguished Lecture on Integrated Control and Power Electronics for Energy and Power Systems, National Instruments, Austin, TX, October 26, 2014.
47. IEEE PELS Distinguished Lecture on Integrated Control and Power Electronics for Energy and Power Systems, Texas Instruments, Sugar Land, TX, October 23, 2014.
48. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), University of Novi Sad, Serbia, May 16, 2014.
49. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), University of Zagreb, Croatia, May 12, 2014 .
50. No More Phase-Locked Loops in Power Electronic Systems, North China Electric Power University, April 21, 2014.
51. IEEE PELS Distinguished Lecture on Integrated Control and Power Electronics for Energy and Power Systems, Beijing Jiaotong University, April 21, 2014.
52. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), Southwest Jiaotong University (SWJTU), April 16, 2014.
53. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), University of Electronic Science and Technology of China (UESTC), April 15, 2014.
54. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), Michigan State University, March 27, 2014.
55. Integrated Control and Power Electronics for Energy and Power Systems ---The Link between Devices and Next-Generation Smart Grids, Illinois Institute of Technology (IIT), February, 2014.
56. IEEE PELS Distinguished Lecture on Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), The University of Southampton, Jan. 29, 2014.
57. Enabling Technologies in Control and Power Electronics for Energy and Power Systems, North China Electric Power University (NCEPU), December 25, 2013.
58. Autonomous Distributed Control of Next-Generation Smart Grids, The Chinese Academy of Sciences (CAS), Institute of Systems Science (ISS), Dec. 19, 2013.
59. Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), The National Renewable Energy Laboratory (NREL), Sept. 20, 2013.
60. Next-Generation Smart Grids: Completely Autonomous Power Systems (CAPS), The University of Colorado Denver, Sept. 19, 2013.
61. Next-Generation Smart Grid: Completely Autonomous Power Systems (CAPS), Tsinghua University, August 16, 2013.

62. Next-Generation Smart Grid: Completely Autonomous Power Systems (CAPS), North China Electric Power University (NCEPU), August 14, 2013.
63. Next-Generation Smart Grid: Completely Autonomous Power Systems (CAPS), The Nanjing University of Aeronautics and Astronautics (NUAA), August 10, 2013.
64. Control of Power Inverters in Renewable Energy and Smart Grid Integration, Wenzhou University, August 9, 2013.
65. Control of Power Inverters in Renewable Energy and Smart Grid Integration, China Southern Grid Electric Power Research Institute (SEPRI), August 6, 2013.
66. Control of Power Inverters in Renewable Energy and Smart Grid Integration, China Three Gorges University, August 3, 2013.
67. Control of Power Inverters in Renewable Energy and Smart Grid Integration, The Hunan University of Science and Technology (HNUST), August 2, 2013.
68. Next-Generation Smart Grid: Completely Autonomous Power Systems (CAPS), China Electric Power Research Institute (CEPRI), July 31, 2013.
69. Next-Generation Smart Grid: Completely Autonomous Power Systems (CAPS), Cardiff University, Cardiff, UK, May 28, 2013.
70. Enabling Technologies in Control and Power Electronics for Energy Systems, University of Southampton, UK, May 29, 2013.
71. Next-Generation Smart Grid: Completely Autonomous Power Systems (CAPS), ALSTOM, Staffordshire, UK, June 26, 2013.
72. Next-Generation Smart Grid: Completely Autonomous Power Systems (CAPS), Imperial College London, UK, May 16, 2013.
73. Integration of Renewable Energy into Smart Grids, University of Texas at Dallas, April 2, 2013.
74. Next-Generation Smart Grid: Completely Autonomous Power Systems (CAPS), University of Cambridge, May 31, 2013.
75. Next-Generation Smart Grid: Completely Autonomous Power Systems (CAPS), The Center for Power Electronics Systems (CPES), Virginia Tech, March 8, 2013.
76. Control of Power Inverters in Renewable Energy and Smart Grid Integration, University of California, Los Angeles (UCLA), January 9, 2013.
77. Control of Power Inverters in Renewable Energy and Smart Grid Integration, China Electric Power Research Institute (CEPRI), Jan. 7, 2013.
78. Control of Power Inverters in Renewable Energy and Smart Grid Integration, University of Tennessee, Knoxville, November 30, 2012.
79. Control of Power Inverters in Renewable Energy and Smart Grid Integration, North Carolina State University (NC State), November 28, 2012.
80. Control of Power Inverters in Renewable Energy and Smart Grid Integration, The University of Colorado Boulder, November 5, 2012.
81. Control of Power Inverters in Renewable Energy and Smart Grid Integration, The University of Massachusetts Amherst, October 30, 2012.
82. Control of Power Inverters in Renewable Energy and Smart Grid Integration, Boston University, November 1, 2012.
83. Control of Power Inverters in Renewable Energy and Smart Grid Integration, Northeastern University, October 31, 2012.
84. Control of Power Inverters in Renewable Energy and Smart Grid Integration, Polytechnic Institute of New York University, October 22, 2012.
85. Control of Power Inverters in Renewable Energy and Smart Grid Integration, The Center for Power Electronics Systems (CPES), Virginia Tech, October 19, 2012.
86. Control of Power Inverters in Renewable Energy and Smart Grid Integration, University of California, Irvine, August 9, 2012.

87. Control of Power Inverters in Renewable Energy and Smart Grid Integration, North China Electric Power University (NCEPU), June 8, 2012.
88. Synchronisation Strategies for Grid Connection of Renewable Energy and Smart Grid Integration, Changsha University of Science and Technology (CSUST), June 1, 2012.
89. Robust Droop Controller for Parallel Operation of Inverters, Hunan Institute of Engineering (HNIE), June 1, 2012.
90. Control of Power Inverters in Renewable Energy and Smart Grid Integration, Huazhong University of Science and Technology, June 4, 2012.
91. Control of Power Inverters in Renewable Energy and Smart Grid Integration, Taiyuan University of Technology, May 24, 2012.
92. Recent Developments in Smart Grid Integration, Tsinghua University, May 19, 2012.
93. Control of Power Inverters in Renewable Energy and Smart Grid Integration, General Atomics, May 2012.
94. Control of Power Inverters in Renewable Energy and Smart Grid Integration, University of California, Santa Barbara, May 4, 2012.
95. Control of Power Inverters in Renewable Energy and Smart Grid Integration, California Institute of Technology, April 30, 2012.
96. Control of Power Inverters in Renewable Energy and Smart Grid Integration, Cymer Center of Control Systems and Dynamics, University of California, San Diego, April 27, 2012.
97. Enabling Technologies in Control and Power Electronics for Smart Grids, INVT, December 31, 2011.
98. C-Inverters: Inverters with Capacitive Output Impedances, Hunan University, December 28, 2011
99. C-Inverters: Inverters with Capacitive Output Impedances, Changsha University of Science and Technology (CSUST), December 28, 2011.
100. C-Inverters: Inverters with Capacitive Output Impedances, Hunan Institute of Engineering, December 27, 2011.
101. Enabling Technologies in Control and Power Electronics for Smart Grids, Shanghai Jiao Tong University (SJTU), December 26, 2011.
102. Synchronverters: Inverters that mimic synchronous generators, Central South University, Oct. 2011.
103. Robust droop controller for Parallel Operation of Inverters, Shandong University, August 2011.
104. Synchronverters: Inverters that mimic synchronous generators, Southwest Jiaotong University (SWJTU), July 26, 2011.
105. Control of power inverters for renewable energy and distributed generation, University of Electronic Science and Technology of China (UESTC), July 27, 2011.
106. Robust Droop Controller for Parallel Operation of Inverters, Changsha University of Science and Technology (CSUST), July, 2011.
107. Control of power inverters for renewable energy and distributed generation, Supélec, France, July 19, 2011.
108. On H-infinity control of time-delay systems, University of Oxford, Oxford, UK, June 23, 2011.
109. Synchronverters: Inverters that mimic synchronous generators, University of Kent, June 14, 2011.
110. Grid Connection of Renewable Energy: Key Technologies, Hunan Institute of Engineering (HNIE), April 27, 2011.
111. Proportional Load Sharing of Inverters in Parallel Operation, NARI Technology, April 22, 2011.
112. Proportional Load Sharing of Inverters in Parallel Operation, Nanjing University of Aeronautics and Astronautics (NUAA), April 21, 2011.
113. Control of Time-Delay Systems and its Applications, North China Electric Power University (NCEPU), April 20, 2011.
114. Platform technologies in control of power inverters for renewable energy and distributed generation, Areva, February, 2011.

115. Control in power electronics and renewable energy: Recent developments, Zhejiang University December 2010.
116. Control of Time-delay Systems and Possible Applications to Supply Chain Management, Cardiff University, November 26, 2010.
117. Control in power electronics and renewable energy: Recent developments, Xi'an University of Technology, July 2010.
118. On standard H-infinity control of time-delay systems, Shanghai Jiao Tong University, April 2010.
119. Control in power electronics and renewable energy: Recent developments Xi'an Jiaotong–Liverpool University (XJTLU), April, 2010.
120. Synchronverters: Inverters that mimic synchronous generators, Sichuan University, March 31, 2010.
121. Control in power electronics and renewable energy: Recent developments, Beihang University (BUAA), March 30, 2010.
122. Control in power electronics and renewable energy: Recent developments, Beijing Institute of Technology (BIT), March 29, 2010.
123. Advanced Control in Distributed Generation and Renewable Energy, Donghua University, Shanghai, China, March, 2010.
124. Synchronverters: Inverters that mimic synchronous generators, Aalborg University, March 9, 2010.
125. H-infinity and repetitive control of grid-connected inverters, Hunan University, December 29, 2009.
126. Synchronverters: Inverters that mimic synchronous generators, City University of Hong Kong, August 26, 2009.
127. Synchronverters: Inverters that mimic synchronous generators, NARI Technology, August 20, 2009.
128. Synchronverters: Inverters that mimic synchronous generators, Shandong University, Aug. 17, 2009.
129. Synchronverters: Inverters that mimic synchronous generators, Hunan University, August 5, 2009.
130. Control in power electronics and renewable energy: Recent developments, Xi'an Jiaotong University, July 30, 2009.
131. Synchronverters: Inverters that mimic synchronous generators, Tsinghua University, July 20, 2009.
132. Synchronverters: Inverters that mimic synchronous generators, University of Cambridge, Cambridge, UK, June 12, 2009.
133. H-infinity and repetitive control for grid-connected inverters in distributed generation and renewable energy, Gdynia Maritime University, June 29, 2009.
134. Provision of a neutral line, Gdynia Maritime University, June 29, 2009.
135. Synchronverters: Inverters that mimic synchronous generators, Gdynia Maritime University, June 29, 2009.
136. Control in power electronics and renewable energy: Recent developments, Ariel University, Israel, June 21, 2009.
137. Synchronverters: Inverters that mimic synchronous generators, Nanjing University of Aeronautics and Astronautics (NUAA), April 8, 2009.
138. Energy Recovery from Landing Aircraft, Nanjing University of Aeronautics and Astronautics (NUAA), April 6, 2009.
139. On standard H-infinity control of time-delay systems, National University of Singapore, March 2007.
140. Control of Integral Processes with Dead Time, National University of Singapore, March 2007.
141. Control of Time-Delay Systems and its Applications, Queen's University of Belfast, June, 2005
142. The delay-type Nehari problem, Queen's University of Belfast, June, 2005.
143. A unified Smith predictor for time-delay systems, The Academy of Mathematics and Systems Science, The Chinese Academy of Sciences (CAS), April 11, 2005.
144. J-spectral factorization of regular para-Hermitian transfer matrices, The Academy of Mathematics and Systems Science, The Chinese Academy of Sciences (CAS), March 28, 2005.

145. The delay-type Nehari problem, The Academy of Mathematics and Systems Science, The Chinese Academy of Sciences (CAS), March 28, 2005.
146. Recent results on H-infinity control of single-delay systems, Imperial College London, April 30, 2004.

Professional Services

- Working Group Chair, IEEE Standard P2988-2024: Recommended Practice for Use and Functions of Virtual Synchronous Machines, 2021 – 2025, https://standards.ieee.org/ieee/2988/10581/.
- IEEE PES Technical Committee Working Group Award for Outstanding Technical Report of Task Force on Measurement, Monitoring and Reliability Issues Related to Primary Governing Frequency Response, 2019.
- Member, IEEE Smart Grid Steering Committee, representing IEEE PELS, 2017 – 2020.
- Member, National Grid Energy System Operator VSM Expert Group (GC0137), 2018-2021.
- Associate Editor for
  - *IEEE Trans. on Power Electronics*, Nov. 2010 – Dec. 2018
  - *IEEE Trans. on Automatic Control,* Jan. 2015 – Dec. 2016
  - *IEEE Trans. on Industrial Electronics*, March 2014 – August 2019
  - *IEEE Trans. on Control Systems Technology*, Jan. 2014 – Dec. 2016
  - *IEEE Access*, March 2013 - 2018
  - *European Journal of Control*, Jan. 2014 – June 2016.
  - *IEEE Journal of Emerging and Selected Topics in Power Electronics*, 2013 -2017
  - Conference Editorial Board of the IEEE Control Systems Society, 2009 – 2016
  - Special Issue on Wind Applications, *IEEE Journal of Emerging and Selected Topics in Power Electronics*, 2013.
  - Special issue on Power Electronics for Microgrids, *IEEE Trans. Power Electronics*, 2010.
- IEEE Power Electronics Society AdCom, 2017
- Reviewer of international grant proposals
  - Canada Foundation for Innovation, 2016
  - Singapore National Research Foundation, 2015
  - Finnish Funding Agency for Technology and Innovation, 2014.
  - Kuwait Foundation for the Advancement of Sciences, 2014.
  - Italian Evaluation of Research Quality exercise (VQR 2004-2010), Italian Ministry of Education, University and Research, 2012.
  - Netherlands NWO, 2013.
  - Israel Science Foundation (ISF), 2013.
  - UK EPSRC, 2008 - 2024, ranked top 6% of all reviewers in 2017/18
- UK representative, European Control Association (EUCA), August 2013 – July 2015.
- Scientific Advisory Board Member, NSF FREEDM Systems Center, North Carolina State Univ., 2014.
- University Technology Partnership Board Member, Rolls-Royce Plc, 2014-2015.
- Member, EPSRC Peer Review College, 2012 – 2024.

- Senior Member of IEEE, 2004 –2016.
- Vice Chair, IFAC Technical Committee 6.3 (Power and Energy Systems), 2011 – 2020.
- Vice Chair, IFAC Technical Committee 2.2 (Linear Control Systems), 2011 – 2017.
- International Editorial Board Member of *Journal of the Chinese Institute of Engineers*, 2003-2008.
- Founding Director, Loughborough Centre in Control Engineering, 2011-2012.
- **Founding Director, New-ACE (EPSRC-funded Network for New Academics in Control Engineering), 2007–2011, UK, attracting 200+ members.** This initiative played a pivotal role with a lasting impact in shaping the future of the UK control community, fostering collaboration, and supporting early-career researchers. Many former members are now leading figures in academia and industry, both in the UK and overseas. His leadership and mentorship in New-ACE laid the groundwork for today's UK Automatic Control Engineering (ACE) Network, funded by EPSRC in 2024.
- Member, IFAC Technical Committee 2.2 (Linear control systems), 2006 -
- Member, IChemE Process Management and Control Subject Group Comm., 2009-2011
- Member, IEEE IES TC on Renewable Energy Systems, 2013 –
- Member, IEEE PELS TC on Sustainable Energy Systems, 2013 –
- Member, IEEE PELS TC on Power & Control Core Technologies, 2013 –
- Member, IEEE CSS TC on Smart Grids, 2013 -
- Member, IEEE CSS TC on Systems with Uncertainty, 2010 -
- Member, IEEE CSS TC on Power Generation, 2010 -
- Member of UK Automatic Control Council (UKACC), 2006 –2010
- Tutorials Chair, ECCE 2016, Milwaukee WI, 2016.
- Track Chair, IECON 2016, Florence, Italy, 2016.
- General Co-Chair (2017), Topic B Chair (2015), International Future Energy Challenge
- IPC Co-Chair of the IFAC Workshop on Time-Delay Systems, Boston, 2012
- Regional Chair (UK), The 10th IEEE International Conference on Control & Automation (IEEE ICCA 2013, Hangzhou, China, June 2013.
- International Program Committee member of
    - 2017 IFAC World Congress, France, July 2017.
    - 11th UKACC International Conference on Control, Belfast, UK, September 2016.
    - 27th Chinese Control and Decision Conference, Qingdao, China, May 23-25, 2015.
    - 2014 IFAC World Congress, South Africa, August 2014.
    - 2014 UKACC International Conference on Control (CONTROL 2014), Loughborough, UK, 9th - 11th July 2014.
    - 26th Chinese Control and Decision Conference, Changsha, China, May 31-June 2, 2014.
    - 2014 Sixth Annual Green Technologies Conference, Texas 78401, USA, April 2014.
    - The 13th IFAC Symposium on Large Scale Complex Systems: Theory and Applications (IFAC LSS 2013), Shanghai, China, July 2013.
    - The 31st Chinese Control Conference, Hefei, Anhui, China, July 25-27, 2012.

- The 24th Chinese Control and Decision Conference, Taiyuan, China, May 2012.
- The 9th World Congress on Intelligent Control and Automation (WCICA 2012), Beijing, China, from July 6 to 8, 2012.
- IFAC Conference on Advances in PID Control, Brescia, Italy, March 2012.
- The 30th Chinese Control Conference (CCC'11), Yantai, China, July 2011.
- The 2010 IEEE Int. Conference on Mechatronics and Automation, Xi'an, China, August 2010.
- The 2010 IEEE Int. Conference on Information and Automation, Harbin, China, June 2010.
- The 8th World Congress on Intelligent Control and Automation, China, July 2010.
- The 9th IFAC Workshop on Time Delay Systems, Prague, June 2010.
- IFAC Conference on Control Methodologies and Technology for Energy Efficiency, CMTEE 2010, Vilamoura, Portugal, March 29-31, 2010
- The 8th IFAC Workshop on Time Delay Systems, Sinaia, Romania, September 2009.
- The 2009 IEEE International Conference on Mechatronics and Automation (ICMA 2009), Changchun, China, August 2009.
- The 6th Workshop on Compatibility and Power Electronics, Badajoz, Spain, May 2009.
- The 7th World Congress on Intelligent Control and Automation, China, June 2008.
- The 5th IEEE International Scientific Workshop on Compatibility in Power Electronics - CPE 2007, Gdansk, Poland, June 2007.
- The 6th IFAC Workshop on Time-Delay Systems, L'Aquila, Italy, July 2006.
- The 1st International Symposium on Systems and Control in Aerospace and Astronautics, Harbin, China, Jan. 2006.
- The Int. Symposium on Systems Theory, Automation, Robotics, Computers, Informatics, Electronics and Instrumentation, Craiova, Romania, 10/2005.
- The 7th Asia-Pacific Conf. On Complex Systems, Cairns Australia, 12/2004.
- The 5th IFAC Workshop on Time-Delay Systems, Leuven, Belgium, 09/2004.

Research Grants

Total funding received in USA (from 2014/08): $2,883,768.

Total funding received in UK: £3,194,534, which is about $6M.

For Illinois Institute of Technology:

No.	Grantees	Project Title	Source	Period	Amount*
1.	Q.-C. Zhong (IIT PI)	GOALI: ASCENT: Online Stability Assessment, Flexibility, and Enhancement of IBR-dominated Power Systems	NSF	9/2023-8/2026	$300,000
2.	Q.-C. Zhong (IIT PI)	Scalable Multi-Timescale Analysis Platform Based on System Transient and Dynamic Models	DOE/ Argonne National Lab	10/2021-9/2024	$210,000
3.	Q.-C. Zhong (PI), M.	Planning Grant: Engineering	NSF	9/2019-	$99,977

* The amount listed here is the share allocated to him if he is a Co-PI or the total funding if he is the PI.

	Shahidehpour, Beibei Ren, Terrence Chambers, Stephen Bayne	Research Center for Communication-network-free, Autonomous, Renewable Electric Power Systems (CARE)		8/2020	
4.	Q.-C. Zhong (PI)	Workshop on Power Electronics-enabled Operation of Power Systems	NSF	7/2019-6/2020	$49,978
5.	Q.-C. Zhong (PI), Z. Li, Z. Shen, A. Flueck, M. Shahidehpour, et al	MRI: Acquisition of Large-Scale Real-Time Simulators for Next-Generation Smart Grids	NSF	10/2018-09/2021	$349,143
6.	Q.-C. Zhong (PI)	Stability and Stabilization of Large-scale Modern Power Systems via the Passivity Theory of Port-Hamiltonian Systems	NSF	07/2018-06/2021	$289,666
7.	S. Bahramirad (PI), M. Shahidehpour, Z. Li, Q.-C. Zhong, et al	Microgrid-Integrated Solar-Storage Technology (MISST) (Project funding: $4.0M)	DoE	01/2017-12/2019	$315,131
				Total	**$1,613,895**

For Syndem LLC:

No.	Grantees	Project Title	Source	Period	Amount*
1.	Q.-C. Zhong (Syndem PI)	Building Pandemic Resilience for Native American Communities	NIST/ PowerAmerica	3/2022-2/2024	$199,996
2.	Z. Zhang (PI), M. Yue, R. Lofaro, N. Zhou, P. Zhang, J. Li, L. Yu, Y. Lin, G. Stefopoulos, S. Upreti, Q.-C. Zhong	Asynchronous Distributed and Adaptive Parameter Tuning (ADAPT) for Hybrid PV Plants (Project funding $2.6M)	DOE	4/2021-3/2024	$240,000
3.	Q.-C. Zhong (PI), Beibei Ren, Stephen Bayne, Mark Harral, Jeff Groenewold	Autonomous Grid-forming Inverters Enabled by Always-on Universal Droop Control without External Communication or Phase-Locked Loops	DOE	2/2020-1/2022	$623,453
4.	Q.-C. Zhong, Y. Wang	Grid-forming, Reliable, Efficient, Affordable, and Transformerlessly-grounded Photovoltaic-storage System (GREAT PVs)	DOE	6/2020-3/2021	$206,424
				Total	**$1,269,873**

For UK universities:

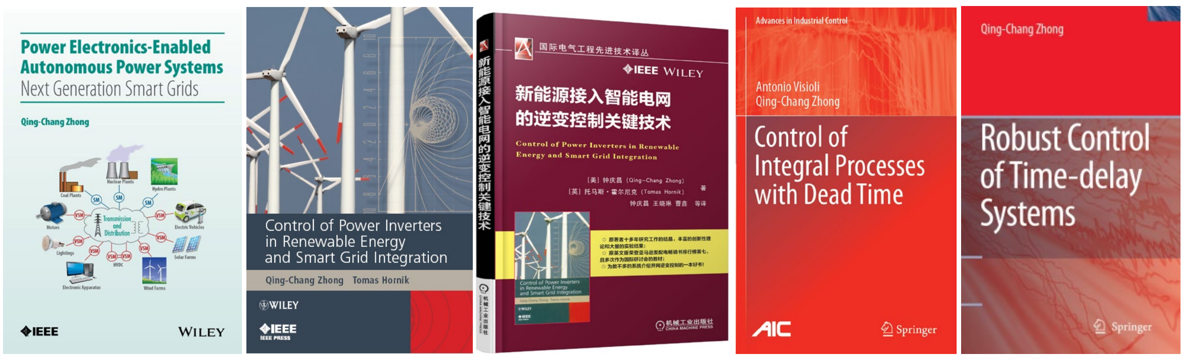
No.	Grantees	Project Title	Source	Period	Amount*
1.	M.P. Foster, D.A. Stone, P. Hall. Q.-C. Zhong and D.T. Gladwin	Grid Connected Energy Storage Research Demonstrator (Project funding: £4.2M)	EPSRC	07/2013-09/2014	£838,147
2.	Q.-C. Zhong and M. Krstic	Distinguished Visiting Fellowship: Robust control of systems with delays and control applications in energy systems	RAEng	05/2013-12/2013	£6,000
3.	Q.-C. Zhong	Developing Fundamental Theory and Enabling Technologies for Parallel	EPSRC	10/2012-09/2015	£459,598

		Operation of Inverters to Facilitate Large-scale Utilisation of Renewable Energy			
4.	Q.-C. Zhong	International Collaboration Sabbatical: To Foster Long-term Collaboration with Leading Control and Power Electronics Experts in the USA	EPSRC	09/2011-09/2012	£179,167
5.	R. Thring (PI), G. Offer, M. McCulloch, Q.-C. Zhong, F. Assadian, et al	Developing FUTURE Vehicles (Fundamental Understanding of Technologies for Ultra Reduced Emission Vehicles) (Project funding: £3.5M)	EPSRC	09/2011-08/2015	£571,423
6.	Q.-C. Zhong	Charging Systems with Grid Support for Electric Vehicles	EPSRC (KTA)	10/2010-08/2012	£126,530
7.	Q.-C. Zhong	Further Development of the Synchronverter Tech. to Increase its Technology-Readiness Level	EPSRC (KTA)	06/2010-05/2011	£120,447
8.	Q.-C. Zhong	HOMES: High-efficiency Off-grid Multi-source Electrical Supplies	EPSRC, PSW & TSB	08/2010-10/2012	£181,527
9.	Q.-C. Zhong	Development of common key technology for grid connection in distributed generation and renewable energy	Royal Academy of Engineering	09/2009-09/2010	£41,292
10.	P. Stewart (PI), Q.-C. Zhong, and M. Eftekhari	Feasibility Study of Energy Recovery from Landing Aircraft (Project funding: £ 199, 224)	EPSRC	07/2009-06/2010	£111,759
11.	E. Burke (PI), P. Stewart, M. Eftekhari, Q.-C. Zhong	SANDPIT: Integrating and Automating Airport Operations (Project funding: £ 681, 924)	EPSRC	10/2009-09/2012	£68,421
12.	Q.-C. Zhong	The 47th IEEE Conference on Decision and Control (travel)	Royal Society	12/2008	£1,280
13.	Q.-C. Zhong	Software Re-configurable Control Circuitry	EPSRC (DHPA)	10/2008-09/2012	£45,000
14.	Q.-C. Zhong	Software Re-configurable Control Circuitry	Add2 Ltd, UK	10/2008-09/2012	£45,000
15.	Q.-C. Zhong	Control System Design for the newly-invented Nheolis ATG Wind turbine	EPSRC (DHPA)	10/2008-09/2012	£45,000
16.	Q.-C. Zhong	Control System Design for the newly-invented Nheolis ATG Wind turbine	Nheolis, France	10/2008-09/2012	£45,030
17.	Q.-C. Zhong	Exploiting Collaborative Oppor-tunities with Chinese Partners in Control and Embedded Systems	Royal Academy of Engineering	06/2008-07/2008	£1,200
18.	Q.-C. Zhong (PI), *et al*	New-ACE: A Network of New Academics in Control Engineering	EPSRC	10/2007-09/2010	£87,800
19.	Q.-C. Zhong	Control of grid-connected inverters in renewable energy power plants	EPSRC (DTA)	10/2007-09/2010	£50,000
20.	Q.-C. Zhong	Control and Stability Analysis of Time-Delay Systems	EPSRC	09/2005-09/2008	£126,413
21.	Q.-C. Zhong	International Travel Grant	Royal Academy of Engineering	06/2006	£600

22.	Q.-C. Zhong	Control and Optimisation Problems in Wind-Hydrogen-Electricity Systems	University of Liverpool	07/2005-07/2006	£6,000
23.	Q.-C. Zhong	International Travel Grant	Royal Academy of Engineering	04/2004	£900
24.	Q.-C. Zhong	A PhD studentship	Univ. of Glamorgan	06/2004	£36,000
				Total	**£3,194,534**

Publications

Research Monographs



[B1] Q.-C. Zhong, *Power Electronics-Enabled Autonomous Power Systems: Next Generation Smart Grids*, Wiley-IEEE Press, 2020. **A Top 3 Best Power Systems Book for Beginners by BookAuthority.org, the world's leading site for book recommendations.**

[B2] Q.-C. Zhong and T. Hornik, *Control of Power Inverters in Renewable Energy and Smart Grid Integration*, Wiley-IEEE Press, 2013, available for download (with subscription or payment) at http://ieeexplore.ieee.org/xpl/bkabstractplus.js p?bkn=6381785 and http://onlinelibrary.wiley.com/book/10.1002/9781118481 806. **It once made No. 7 of Best Sellers in Power Generation and Distribution on amazon.co.uk and the global rights in Chinese were licensed out within three months of its publication.**

[B3] A. Visioli and Q.-C. Zhong, *Control of Integral Processes with Dead Time*, Springer-Verlag Limited, London, 2010, available for download (with subscription or payment) at http://www.springer.com/engineering/robotics/ book/978-0-85729-069-4.

[B4] Q.-C. Zhong, *Robust Control of Time-delay Systems*. ISBN: 1-84628-264-0. Springer-Verlag Limited, London, 2006, available for download (with subscription or payment) at http://www.springer.com/engineering/control/book/978-1-84628-264-5.

Academic Journal Papers

[1] K. Norman, B. Ren and Q.-C. Zhong, Learning-by-Doing: Design and Implementation of a Solar Array Simulator With a SYNDEM Smart Grid Research and Educational Kit, *IEEE Power Electronics Magazine*, vol. 11, no. 1, pp. 47-54, March 2024.

[2] Q.-C. Zhong and M. Stefanello, Generic Modeling and Control Framework for Power Systems Dominated by Power Converters Connected Through a Passive Transmission and Distribution Grid, *CSEE Journal of Power and Energy Systems*, vol. 10, no. 1, pp. 292-301, Jan. 2024.

[3] C. Qi, K. Wang, Q.-C. Zhong, J. Xu, and G. Li, Transient Angle Stability of Inverters Equipped with Robust Droop Control, *CSEE Journal of Power and Energy Systems*, vol. 9, no. 2, pp. 659-670, March 2023.

[4] Y. Dong, B. Ren and Q. -C. Zhong, Bounded Universal Droop Control to Enable the Operation of Power Inverters Under Some Abnormal Conditions and Maintain Voltage and Frequency Within Predetermined Ranges, *IEEE Trans. on Industrial Electronics*, vol. 69, no. 11, pp. 11633-11643, Nov. 2022.

[5] Q.-C. Zhong, and M. Stefanello, A Port-Hamiltonian Control Framework to Render a Power Electronic System Passive, *IEEE Trans. on Automatic Control*, vol. 67, no.4, 1960 - 1965, 2022.

[6] Z. Tian, Q.-C. Zhong, B. Ren, J. Yuan, UDE-based Robust Control for Systems with Mismatched Uncertainties via Feedback Compensation, *Int. Journal of Control*, vol. 94, no. 7, pp. 1723-1733, 2021.

[7] C. Wang, Q.-C. Zhong, N. Zhu, S. Chen, and X. Yang, Space Vector Modulation in the 45° Coordinates α'β' for Multilevel Converters, *IEEE Trans. on Power Electronics*, vol. 36, no. 6, pp. 6525-6536, 2021.

[8] Y. Wang, B. Ren, Q.-C. Zhong, and J. Dai, Bounded Integral Controller with Limited Control Power for Nonlinear Multiple-Input and Multiple-Output Systems, *IEEE Trans. on Control Systems Technology*, vol. 29, no. 3, pp. 1348-1355, 2021.

[9] Y. Wang, B. Ren, and Q.-C. Zhong, Bounded UDE-based Controller for Input Constrained Systems with Uncertainties and Disturbances, *IEEE Trans. on Industrial Electronics*, vol.68, no.2, pp. 1560-1570, 2021.

[10] Q.-C. Zhong, Y. Wang, Y. Dong, B. Ren and M. Amin, Go Real: Power Electronics From Simulations to Experiments in Hours, *IEEE Power Electronics Magazine*, vol. 7, no. 3, pp. 52-61, 2020

[11] M. Amin, Q.-C. Zhong, and Z. Lyu, An Anti-islanding Protection for VSM Inverters in Distributed Generation*, IEEE Open Journal of Power Electronics*, vol.1, no.1, pp. 378-382, 2020.

[12] B. Ren, J. Dai, and Q.-C. Zhong, UDE-based Robust Output Feedback Control with Applications to a Piezoelectric Stage, *IEEE Trans. on Industrial Electronics*, vol.67, no.9, pp. 7819-7828, 2020.

[13] M. Amin and Q.-C. Zhong, Resynchronization of Distributed Generation based on the Universal Droop Controller for Seamless Transfer Between Operation Modes, *IEEE Trans. on Industrial Electronics*, vol.67, no.9, pp. 7574-7582, 2020.

[14] Q.-C. Zhong, Yeqin Wang, and Beibei Ren, Connecting the Home Grid to the Public Grid: Field Demonstration of Virtual Synchronous Machines, *IEEE Power Electronics Magazine*, vol. 6., No. 4, pp. 41-49, Dec. 2019.

[15] S.Y. Gadelovits, D. Insepov, V. Kadirkamanathan, Q.-C. Zhong, and A. Kuperman, UDE-Based Controller Equipped with a Multiple-Time-Delayed Filter to Improve the Voltage Quality of Inverters, *IEEE Trans. on Industrial Electronics*, vol.66, no.11, pp. 8947-8957, 2019.

[16] Z. Tian, Q.-C. Zhong, B. Ren, J. Yuan, Stabilisability analysis and design of UDE-based robust control, *IET Control Theory & Applications*, Vol. 13, No. 10, pp. 1445-1453, 2019.

[17] Q.-C. Zhong and Z. Lyu, Droop-Controlled Rectifiers that Continuously Take Part in Grid Regulation, *IEEE Trans. on Industrial Electronics*, vol. 66, no. 8, pp. 6516-6526, 2019.

[18] X. Zhang, Q.-C. Zhong, V. Kadirkamanathan, J. He, and J. Huang, Source-side Series-virtual-impedance Control to Improve the Cascaded System Stability and the Dynamic Performance of Its Source Converter, *IEEE Trans. on Power Electronics*, vol.34, no.6, pp. 5854-5866, 2019.

[19] Q.-C. Zhong and X. Zhang, Impedance-Sum Stability Criterion for Power Electronic Systems with Two Converters/Sources, *IEEE Access*, vol. 7, pp. 21254-21265, 2019.

[20] G. Konstantopoulos and Q.-C. Zhong, Current-limiting DC/DC Power Converters, *IEEE Trans. on Control Systems Technology*, vol.27, no. 2, 855-863, 2019.

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[251] Q.-C. Zhong, Phase-Sequence Detector, Application of Electronic Technique, 1992, 10. The very first paper. Thirty years later, the technology is adopted in Syndem VSM products.

Teaching and Mentorship

- PhD students supervised to completion:
  - Duo Wang, Large-Signal Transient Stability and Control of Inverter-Based Resources, Illinois Institute of Technology, May 2024.
  - Zijun Lv, Active Load Control in a Synchronized-and-Democratized (SYNDEM) Smart Grid, Illinois Institute of Technology, December 2021.
  - Xin Zhang, Impedance Control and Stability of DC/DC Converter Systems, University of Sheffield, 2016, awarded **the Grand Prize of National Awards for Outstanding Chinese Students Abroad** (10 awards around the world).
  - Yu Zeng, Droop Control of Parallel-Operated Inverters, University of Sheffield, 2015.
  - Wen-Long Ming, Active Control of Voltage Ripples in Power Electronic Converters, University of Sheffield, 2015, **awarded the National Awards for Outstanding Chinese Students Abroad** by **the China Scholarship Council (500 awards around the world), and the Control & Automation PhD Award by Institute of Engineering and Technology (IET),** UK, 2017.
  - Shamsul Aizam Zulkifli, Energy Recovery from Landing Aircraft, Loughborough University, 2012.
  - Zhenyu Ma, Synchronverter-based Control for Wind Power, Loughborough University, 2012.
  - Phi-Long Nguyen, Rapid Control Prototyping and Hardware-in-the-Loop: Platform Development and Applications in Energy Systems, Loughborough University, 2012.
  - Tomas Hornik, Power Quality in Microgrids, University of Liverpool, 2010.
- Partial List of Postdocs and Visiting Scholars
  - Yang Ruan, 07/2018-07/2019
  - Mohammad Amin, 8/2017-4/2019
  - Cui Wang, 9/2017 – 8/2020
  - Yibo Zhang, 4/2019 – 4/2020
  - Wen Huang, 10/2018- 10/2019
  - Chen Qi, 10/2017 – 10/2019
  - Shungang Xu, 3/2018-3/2019
  - Junjie Hong, 2/2018 –2/2019
  - Zhiwei Jia, 12/2017-12/2018
  - Zhen Tian, 8/2017-5/2019
  - Pietro Lorenzetti, 10/2018-12/2018
  - Songrong Wu, 1/2017-1/2018
  - Tiancong Shao, 10/2016-10/2017
  - Márcio Stefanello, 07/2016 – 7/2017
  - Xiaoqiang Dang, 03/2016 -03/2017
  - Youjun Zhang, 2/2016 – 2/2017
  - Andre Yamashita, 1/2016 – 1/2017

- Yalan Xu, 08/2016 – 12/2016
  - Ying Liang, 12/2015 - 12/2016
  - Defeng Wu, 12/2015 – 12/2016
  - Dongqi Liu, 11/2015 – 11/2016
  - Yangyang Zhao, 10/2015 –10/2016
  - Pedro J. Garcia, 2014
  - Lingfei Xiao, 2013
  - George C. Konstantopoulos, 2013-2015
  - Tudor C. Ionescu, 09/2013-09/2015
  - Yao Zhang, 05/2013 - 04/2016
  - Jun Cai, 03/2013-03/2015
  - Xianghua Ma, 06/2012-06/2013
  - Xin Cao, 06/2011-09/2012
  - Shaosheng Fan, 2010-2011
  - Xiaolin Wang, 2009-2010
  - Wuneng Zhou, 12/2009-1/2010.1
  - Alon Kuperman, 2008-2009
  - Said Hadd, 2006-2008
- Teaching activities
  - Modules coordinated/taught
    - Next-Generation Smart Grids, 2018-
    - Robust Control, 2016-
    - Power Electronics Dynamics and Control, 2015-
    - Robust and hybrid control, 2014
    - Advanced Control, 2013
    - Computing, 2011
    - Power Electronics and Electromechanics (ELEC302), 2005-2009
    - Energy Conversion and Power Systems (ELEC220), 2005-2009
    - Digital Control (ELEC303), 2005-2009
    - Continuous and Discrete-time Signals and Systems (ELEC270), 2005-2009
    - MEng Group Project (ELEC450), 2005-2009
    - MEng Group Project for IE (ELEC451), 2005-2009
    - Electrical Principles, Methods & Simulation (EM2H09), 2004-2005
    - Measurement System Design (EM3S07), 2004-2005
    - Mechatronics - Automation and Control (EM3S03), 2004-2005
    - Power Electronics and Drives (EM3S02), 2004-2005
  - Other teaching interests: Classical and Modern Control Theory, Drives etc
  - Lab coordinator for Aerospace Eng. students Year 1 EE lab, 2005-2009
  - Lab demonstration for Year 2 EE students, Imperial College London, 2002
  - Supervision of final-year projects for MEng, MSc and BEng students:
    - Univ. of Liverpool: 2006-2010; **one student, Tomas Hornik, won the IET Prize** (2007).
    - Univ. of Glamorgan: 2004-2005.
    - Imperial College London: 2002-2003.

  - Shanghai Jiao Tong University: 1998.
  - Hunan University: 1995-1996, **one of the students, Shutao Li, was awarded the Best Thesis Award**.
  - Xiangtan Inst. of Mech. and Elec. Tech.: 1990-1993, projects covered temperature control, AC/DC drive, NC lathes, elevator control etc.
- Courses taught at Xiangtan Institute of Mech. and Elec. Tech. (1990-1993) include Industrial Control Devices, Electrics Experiments (electric circuits, DC motor, AC motor etc), Electronics Experiments (analogue and digital circuits), Power Electronics Experiments (power electronics, AC/DC drive), Micro-computer Control Systems Experiments (assembly language, program logic controller, single-chip computer etc.).

Patents

[P1]. Q.-C. Zhong, Power Electronic Converter with a Ground Fault Detection Unit that Shares a Common Ground with both DC Ports and AC Ports, UK patent GB2586343 (GB2010378.4 filed on July 7, 2020).

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Entrepreneurship and Commercialization

- Founded Syndem LLC in Greater Chicago in 2017 to commercialize the VSM technologies and the SYNDEM architecture for worldwide deployment to facilitate large-scale utilization of renewable energy resources and autonomous operation of power systems with distributed energy players, enhancing grid security and advancing energy freedom and energy equity. Its major milestones are listed below.
  - 2018: Developed SYNDEM Smart Grid Research and Educational Kits to train next-generation engineers equipped with hands-on skills in control and power electronics to meet the increasing demand of a qualified workforce [10]. Now sold to 10+ countries.
  - 2018: Recognized as a finalist for Exelon's Climate Change Investment Initiative (2c2i).
  - 2019: Developed and field-tested its silicon-based 3kW VSM inverters [14] at a brand-new home in Texas, which is powered by six SYNDEM VSM - four for solar panels and one for a wind turbine, and one as an Energy Bridge for grid interaction. They are connected together to form a home grid, making it a 100% power-electronic-converter-based grid. The home grid can autonomously regulate the frequency and voltage without relying on communication. There is no central controller either. The home grid can disconnect from the utility grid if there is a fault on the utility grid. When the utility grid is recovered, the SYNDEM Energy Bridge will automatically synchronize with and then connect to it, seamlessly. When it is disconnected from the utility grid, the home grid is 100% renewable. See a short video at https://www.youtube.com/watch?v=vpvc_4-wkLI.
  - 2019: Recognized by New York State Energy Research and Development Authority (NYSERDA) as a semifinalist for $1M 76west Competition, which is “one of the largest” competitions in U.S. that focuses on supporting entrepreneurs to build clean-energy businesses and economic development.
  - 2020: Secured a grant (DE-EE0009030) from the U.S. Department of Energy Solar Energy Technology Office to further develop its VSM control algorithms for solar applications.
  - 2020: Secured an SBIR Phase I project from the U.S. Department of Energy Office of Science to develop a 6kW split-phase inverter (functional prototype) for U.S. residential solar applications.
  - 2021: Selected as the sole vendor to supply 30 VSM for DOE project DE-EE0009341 with the field tests to be carried out at Brookhaven National Lab.
  - 2021: Invested to cast Syndem’s own single-piece recyclable aluminum enclosure for products.
  - 2021: Established in-house design/testing/manufacturing capabilities for converters up to 20kW.
  - 2022: Field-tested VSM technologies (not products) for DOE project DE-EE0009030 with 20 SYNDEM Smart Grid Research and Educational Kits equipped with the VSM technologies [M5], connected to solar panels in the field and batteries inside the project container. See a short video at https://www.youtube.com/watch?v=00UBV9Kk30c.
  - 2022: Secured funding (sub-awardee of PowerAmerica) from National Institute of Standards and Technology, Department of Commerce to build pandemic resilience in remote, difficult to reach, underserved Native American communities through clean-energy-powered services.
  - 2022: Offered investment by mHUB Product Impact Fund, after going through a lengthy competition
  - 2023: Commissioned the SYNDEM Smart Grid Testbed with 108 physical power converters [M4], which is a world-class facility for future power systems with over 100 physical power electronic converters, in collaboration with Texas Tech University (TTU). See a short video at https://youtu.be/WzkTIEU4e4M.
  - 2024: Started shipping its 9kW VSM products to domestic and overseas customers. See a video of five 9kW VSM working together at https://www.youtube.com/watch?v=8ePnhBYouxs.
  - 2024: Recognized as a Top 3 Power Electronics Startup Out Of 123 In Grid Modernization by Innovation intelligence firm StartUs Insights [M2].
  - 2024: Listed in 8 Best Smart Grid Companies to Watch in 2025 by ClimateSort.com [M3].

- 2025: Recognized as a Top Key Player in Smart Energy Market, prophecymarketinsights.com [M1].
- 2025: IEEE published IEEE Std 2988-2024 on Virtual Synchronous Machines, of which the development was led by Syndem's CEO, https://standards.ieee.org/ieee/2988/10581/.
- 2025: Generated over $1.5M sales revenue so far, sustaining Syndem's organic growth.

- Licensed the syncronverter patent (EP2377238, US 8,880,236, CN102257720A, WO2010055322A3) [P16] to Synvertec, an Israeli startup company, 2014.
- Commercialized the China Patent CN2119743U [P18], established the supply chain, manufactured products at 100 units/batch, attracted a radio network for complimentary advertisements, and generated sales revenues, 1992.


Smart home powered by six Syndem 3kW VSM


Field tests of VSM technologies with 20 Inverters

Large-scale demonstration of SYNDEM architecture and VSM technologies
in collaboration with Texas Tech University (TTU)