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Research interests

Chaoyun Song (宋超运) received his BEng (Hons.), MSc (with distinction) and PhD degrees all in electrical engineering and electronics from The University of Liverpool (UoL), Liverpool, UK, in 2012, 2013 and 2017, respectively. He worked as a Postdoctoral Research Associate at UoL under Prof. Yi Huang (IEEE Fellow) and Prof. Jianliang Xiao (Fellow of Royal Society of Chemistry) between 2017 and 2020. He is currently an Assistant Professor at ISSS of School of Engineering and Physical Sciences, Heriot-Watt University in Edinburgh, UK. He is a faculty member of the Microwave and Antenna Engineering Research Group, led by Prof. George Goussestis and Prof. Jiasheng Hong (IEEE Fellow).

He has published more than 80 articles (including 35 IEEE Transactions) in peer-reviewed journals and conference proceedings. He has held two U.S. patents and two U.K. patents. His current research interests include wireless energy harvesting and wireless power transfer technologies, antennas and microwave circuits using novel materials, dielectric material and ionic liquids in RF applications, metamaterials and metasurfaces in RF, and energy harvesting and sensing technologies. Dr. Song was a recipient of many international awards, such as the BAE Systems Chairman's Award in 2017 for the innovation of next-generation global navigation satellite system antennas. In 2018, he received the Highly-Commended Award from the prestigious IET Innovation Awards over three categories—"Energy and Power," "Emerging Technologies," and "Young Innovators." He has been a regular Reviewer of more than 25 international journals, including Nature Communications, Applied Physics Letters, Nano Energy, and seven IEEE Transactions, and an Associate Editor of Frontiers in Communications and Networks, 2022 - present, and a Guest Editor of Wireless Communications and Mobile Computing.

Qualifications

Nov 2013 → Jul 2017 Doctor Of Philosophy, PhD

Employment

Assistant Professor

School of Engineering & Physical Sciences
Heriot-Watt University
1 Mar 2020 → present

Assistant Professor

Institute of Sensors, Signals & Systems
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1 Mar 2020 → present

Research outputs

Electromagnetic Shielding Using Flexible Embroidery Metamaterial Absorbers: Design, Analysis and Experiments

Yang, Y., Wang, J., Song, C., Pei, R., Purushothama, J. M. & Zhang, Y., Oct 2022, In: Materials & Design. 222, 111079.

Energy Efficient Time-Modulated OFDM Directional Modulation Transmitters

Hou, J., Methapettyparambu Purushothama, J., Fan, H., Song, C., Ding, Y. & Sellathurai, M., 6 Aug 2022, (Accepted/In press) In: Microwave and Optical Technology Letters.

Standalone stretchable RF systems based on asymmetric 3D microstrip antennas with on-body wireless communication and energy harvesting

Zhang, S., Zhu, J., Zhang, Y., Chen, Z., Song, C., Li, J., Yi, N., Qiu, D., Guo, K., Zhang, C., Pan, T., Lin, Y., Zhou, H., Long, H., Yang, H. & Cheng, H., 1 Jun 2022, In: Nano Energy. 96, 107069.

Stretchable 3D Wideband Dipole Antennas from Mechanical Assembly for On-Body Communication

Zhu, J., Hu, Z., Zhang, S., Zhang, X., Zhou, H., Xing, C., Guo, H., Qiu, D., Yang, H., Song, C. & Cheng, H., 16 Mar 2022, In: ACS Applied Materials and Interfaces. 14, 10, p. 12855-12862 8 p.

Wideband Low-Profile Patch Antennas Using High-Dielectric Fluids and Hybrid Metal Structure

Song, C., Wang, L., Goussetis, G., Yang, X. & Huang, Y., 16 Feb 2022, *2021 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting*. IEEE, p. 1943-1944 2 p.

Advances in Wirelessly Powered Backscatter Communications: From Antenna/RF Circuitry Design to Printed Flexible Electronics

Song, C., Ding, Y., Eid, A., Hester, J. G. D., He, X., Bahr, R., Georgiadis, A., Goussetis, G. & Tentzeris, M. M., Jan 2022, In: Proceedings of the IEEE. 110, 1, p. 171-192 22 p.

Near-Field Bessel-Gauss Antenna for Non-Metal Internal Defects Detection

Yang, X., Li, W., Lu, P., Liu, Q., Zou, Y., Xie, Y., Song, C. & Qiu, Y., Dec 2021, In: IEEE Antennas and Wireless Propagation Letters. 20, 12, p. 2466-2470 5 p.

Strain-Insensitive Hierarchically Structured Stretchable Microstrip Antennas for Robust Wireless Communication

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Wireless Power Transfer with Distributed Antennas: System Design, Prototype, and Experiments

Shen, S., Kim, J., Song, C. & Clerckx, B., Nov 2021, In: IEEE Transactions on Industrial Electronics. 68, 11, p. 10868-10878 11 p.

Optimal Power Splitting of Wireless Information and Power Transmission using a Novel Dual-Channel Rectenna

Lu, P., Huang, K. M., Song, C., Ding, Y. & Goussetis, G., 15 Oct 2021, (E-pub ahead of print) In: IEEE Transactions on Antennas and Propagation.

Highly Efficient Omnidirectional Integrated Multi-Band Wireless Energy Harvesters for Compact Sensor Nodes of Internet-of-Things

Song, C., Lu, P. & Shen, S., Sep 2021, In: IEEE Transactions on Industrial Electronics. 68, 9, p. 8128-8140 13 p.

Ultra-Wideband Rectenna Using Complementary Resonant Structure for Microwave Power Transmission and Energy Harvesting

Lu, P., Song, C. & Huang, K. M., Jul 2021, In: IEEE Transactions on Microwave Theory and Techniques. 69, 7, p. 3452-3462 11 p.

Stretchable wideband dipole antennas and rectennas for RF energy harvesting

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An Efficient Method for Complex Antenna Design Based on a Self Adaptive Surrogate Model Assisted Optimization Technique

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Space Matching for Highly Efficient Microwave Wireless Power Transmission Systems: Theory, Prototype, and Experiments

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Dynamic Wireless Power Transfer System With an Extensible Charging Area Suitable for Moving Objects

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An Approach to Improve the Misalignment and Wireless Power Transfer into Biomedical Implants Using Meandered Wearable Loop Antenna

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Second Harmonic Exploitation for High-Efficiency Wireless Power Transfer Using Duplexing Rectenna

Joseph, S. D., Huang, Y., Hsu, S. S. H., Alieldin, A. & Song, C., Jan 2021, In: *IEEE Transactions on Microwave Theory and Techniques*. 69, 1, p. 482-494 13 p.

Liquid Antennas: Past, Present and Future

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Multi-Mode Hybrid Antennas Using Liquid Dielectric Resonator and Magneto-Electric Dipole

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Wearable EBG-Backed Belt Antenna for Smart On-body Applications

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A Two-Port Multi-Polarization Rectenna with Orthogonal Hybrid Coupler for Simultaneous Wireless Information and Power Transfer (SWIPT)

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A Self-Biased Adaptive Reconfigurable Rectenna for Microwave Power Transmission

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A Compact Rectenna Design With Wide Input Power Range for Wireless Power Transfer

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Generalised probe method to measure the liquid complex permittivity

Xing, L., Zhu, J., Xu, Q., Zhao, Y., Song, C. & Huang, Y., 1 Jul 2020, In: *IET Microwaves, Antennas and Propagation*. 14, 8, p. 707-711 5 p.

Signal Modulation Schemes in Backscatter Communications

Ding, Y., Goussetis, G., Correia, R., Borges Carvalho, N., Lihakanga, R. & Song, C., 18 May 2020, (Accepted/In press) *Backscattering and RF Sensing for Future Wireless Communication*. Abbasi, Q. H., Abbas, H. T., Alomainy, A. & Imran, M. A. (eds.). Wiley

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A Dual-Band Dual-Polarized Base Station Antenna Using a Novel Feeding Structure for 5G Communications

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Progress, challenges, and perspective on metasurfaces for ambient radio frequency energy harvesting

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Broadband Metasurface Antenna Using Hexagonal Loop-Shaped Unit Cells

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High-Power Wire Bonded GaN Rectifier for Wireless Power Transmission

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Improving Current Transformer-based Energy Extraction from AC Power Lines by Manipulating Magnetic Field

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A 2.45-GHz Rectifier-Booster Regulator With Impedance Matching Converters for Wireless Energy Harvesting

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Metasurfaced, Broadband, and Circularly Polarized Liquid Antennas Using a Simple Structure

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A Novel Quartz Clock With Integrated Wireless Energy Harvesting and Sensing Functions

Song, C., Lopez-Yela, A., Huang, Y., Segovia-Vargas, D., Zhuang, Y., Wang, Y. & Zhou, J., May 2019, In: *IEEE Transactions on Industrial Electronics*. 66, 5, p. 4042-4053 12 p.

Compact Ultra-Wideband Monopole Antennas Using Novel Liquid Loading Materials

Song, C., Bennett, E. L., Xiao, J., Hua, Q., Xing, L. & Huang, Y., 9 Apr 2019, In: *IEEE Access*. 7, p. 49039-49047 9 p.

A Novel Rectenna Array with RBR for Long-Distance WLAN Energy Harvesting System

Fan, S., Gou, W., Zhao, Y., Song, C., Huang, Y., Zhou, J. & Geng, L., 14 Feb 2019, *2018 IEEE Wireless Power Transfer Conference (WPTC)*. IEEE, 8639266

A Novel Compact Quadruple-Band Indoor Base Station Antenna for 2G/3G/4G/5G Systems

Hua, Q., Huang, Y., Song, C., Akinsolu, M. O., Liu, B., Jia, T., Xu, Q. & Alieldin, A., 2019, In: *IEEE Access*. 7, p. 151350-151358 9 p.

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Multi-coil high efficiency wireless power transfer system against misalignment

Xu, C., Zhuang, Y., Han, H., Song, C., Huang, Y. & Zhou, J., 2 Jul 2018, *2018 IEEE MTT-S International Wireless Symposium (IWS)*. IEEE, 8400877

Novel Compact and Broadband Frequency-Selectable Rectennas for a Wide Input-Power and Load Impedance Range

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A High-Efficiency Helical Core for Magnetic Field Energy Harvesting

Yuan, S., Huang, Y., Zhou, J., Xu, Q., Song, C. & Yuan, G., Jul 2017, In: *IEEE Transactions on Power Electronics*. 32, 7, p. 5365-5376 12 p.

A Watch Strap Antenna for the Applications of Wearable Systems

Li, G., Gao, G., Bao, J., Yi, B., Song, C. & Bian, L., 13 Jun 2017, In: *IEEE Access*. 5, p. 10332-10338

Numerical Analysis of a Transmission Line Illuminated by a Random Plane-Wave Field Using Stochastic Reduced Order Models

Fei, Z., Huang, Y., Zhou, J. & Song, C., 8 May 2017, In: *IEEE Access*. 5, p. 8741-8751

Matching Network Elimination in Broadband Rectennas for High-Efficiency Wireless Power Transfer and Energy Harvesting

Song, C., Huang, Y., Zhou, J., Carter, P., Yuan, S., Xu, Q. & Fei, Z., May 2017, In: *IEEE Transactions on Industrial Electronics*. 64, 5, p. 3950-3961 12 p.

3-D Antenna Radiation Pattern Reconstruction in a Reverberation Chamber Using Spherical Wave Decomposition

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Improved Ultrawideband Rectennas Using Hybrid Resistance Compression Technique

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A Novel Six-Band Dual CP Rectenna Using Improved Impedance Matching Technique for Ambient RF Energy Harvesting

Song, C., Huang, Y., Carter, P., Zhou, J., Yuan, S., Xu, Q. & Kod, M., Jul 2016, In: *IEEE Transactions on Antennas and Propagation*. 64, 7, p. 3160-3171 12 p.

The Limit of the Total Scattering Cross Section of Electrically Large Stirrers in a Reverberation Chamber

Xu, Q., Huang, Y., Xing, L., Tian, Z., Song, C. & Stanley, M., Apr 2016, In: *IEEE Transactions on Electromagnetic Compatibility*. 58, 2, p. 623-626 4 p.

A Modified Two-Antenna Method to Measure the Radiation Efficiency of Antennas in a Reverberation Chamber

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Shielding Effectiveness Measurement of an Electrically Large Enclosure Using One Antenna

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Magnetic Field Energy Harvesting Under Overhead Power Lines

Yuan, S., Huang, Y., Zhou, J., Xu, Q., Song, C. & Thompson, P., Nov 2015, In: *IEEE Transactions on Power Electronics*. 30, 11, p. 6191-6202 12 p.

A High-Efficiency Broadband Rectenna for Ambient Wireless Energy Harvesting

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