Heng Chun Huat

Associate Professor

PhD UIUC; 2003
MEng NUS; 1999
BEng(Hons) NUS; 1996

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Professional Working Experience

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1997-1998 Senior Tutor at National University of Singapore
2001-2003 IC Designer at Wireless Interface Technologies, US
2003-2004 IC Designer at Chrontel, US
2013-2014 Area Director for ICES
2014-present Associate Head (UG Programme)
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Professional Activities

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IEEE Senior Member
Associate Editor for IEEE Transactions on Circuits and Systems II: Expres
s Briefs 2011-2013
Technical Program Committee Member for International Solid-State Circuits
 Conference
Technical Program Committee Member for Asian Solid-State Circuits Confere
nce
Technical Program Committee Co-Chair for Radio Frequency Integration Tech
nology 2012
Technical Program Committee Member for IEEE International Wireless Sympos
ium 2013
University Design Contest Chair for Asia and South Pacific Design Automat
ion Conference 2014
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Research Interest

1. RF and Mixed-Signal CMOS IC
2. VLSI implementation of DSP
3. Spice modeling and circuit applications of novel devices
4. OPC for IC mask design flow

Patents Granted

1. D. Kang, C. H. Heng, "Complex digital signal channel select filter for analog cable television," US Patent, No. 7463874, granted Dec. 2008.
2. S. J. Cheng, Y. Gao, C. H. Heng, "Transmitter," US Patent, No. 9148323 B2, granted Sep. 2015.
3. S. J. Cheng, Y. Gao, Y. Zheng, C. H. Heng, "Frequency shift keying transmitter," US Patent, No. 9331878 B2, granted May 2016.
4. Z. Luo, B. Lau, C. H. Heng, Y. Lian, "Ultra low voltage ring oscillator with redundant inverter," US Patent, No. 9698763 B1, granted July 2017.

Selected Publications

Journal Papers

1. C. H. Heng and B. S. Song, "1.8-GHz CMOS fractional-N frequency synthesizer with randomized multiphase VCO," IEEE J. of Solid-State Circuits, Vol. 38, pp. 848-854, June 2003.
2. T. Cho, D. Kang, C. H. Heng, B. S. Song, "2.4GHz dual-mode 0.18um CMOS transceiver for Bluetooth and 802.11b," IEEE J. of Solid-State Circuits, Vol. 39, pp. 1916-1926, Nov. 2004.
3. C. H. Heng, D. Kang, M. gupta, S. Lee, B. S. Song, "A CMOS TV tuner/demodulator IC with digital image rejection," IEEE J. of Solid-State Circuits, Vol. 40, pp. , Dec. 2005. **(Invited)**
4. J. Lin, E. H. Toh, C. Shen, D. Sylvester, C. H. Heng, G. Samudra, Y. C. Yeo, "Compact HSPICE model for IMOS device," Electronics Letters, Vol. 44, pp. 91-92, Jan. 2008.
5. S. Diao, Y. Zheng, C. H. Heng, "A CMOS ultra low power and highly efficient UWB-IR transmitter for WPAN applications," IEEE Trans. on Circuits and Systems II, vol. 56, pp. 200-204, Mar. 2009.
6. Y. Hong, Y. Yang, L. Yang, G. S. Samudra, C. H. Heng,and Y. C. Yeo, "SPICE behavioral model of the tunneling field-effect transistor for circuit simulation," IEEE Trans. On Circuits and Systems II, vol. 56, no. 12, pp. 946-950, Dec. 2009.
7. S. H. Teh, C. H. Heng, and A. Tay, "Performance-based optical proximity correction methodology," IEEE Trans. On Computer-Aided Design of Integrated Circuits and Systems, vol. 29, pp. 51-64, no. 1, Jan. 2010.
8. S. H. Teh, C. H. Heng, and A. Tay, "Adaptive library-based device performance-driven optical proximity correction," Electronics Letters, vol. 46, no. 7, pp. 513-515, Apr. 2010.
9. P. Guo, Y. Yang, G. S. Samudra, C. H. Heng, and Y. C. Yeo, "Temperature independent current biasing employing TFET," Electronics Letters, vol. 46, no. 11, pp. 786-787, May. 2010.
10. K. Kang, F. Lin, D. D. Pham, J. Brinkhoff, C. H. Heng, Y. Guo, and X. Yuan, "60-GHz OOK receiver with an on-chip antenna in 90nm CMOS," IEEE J. of Solid-State Circuits, vol.45, pp.1720-1731, Sep. 2010.
11. S. J. Cheng, L. Qiu, Y. Zheng, C. H. Heng,"50-250MHz DS DLL for Clock Synchronization," IEEE J. of Solid-State Circuits, vol.45, pp.2445-2456, Nov. 2010.
12. M. Nair, Y. Zheng, C. W. Ang, Y. Lian, X. Yuan, and C. H. Heng, "A low SIR impulse-UWB transceiver utilizing chirp FSK in 0.18um CMOS," IEEE J.

of Solid-State Circuits, vol.45, pp.2388-2403, Nov. 2010.
13. C. H. Heng, A. Bansal, and Y. Zheng, "Design of 1.94GHz CMOS noise cancellation VCO," IEEE. Trans. on Microwave Theory and Techniques, vol. 59,
pp. 368-374, Feb. 2011.
14. Y. Gao, Y. Zheng, S. Diao, C. W. Ang, M. Je, and C. H. Heng, "Low power ultra-wideband wireless telemetry transceiver for medical sensor applications," IEEE Trans. on Biomedical Engineering, vol. 58, pp. 768-772, Mar. 2011.
15. W. D. Toh, Y. Zheng, and C. H. Heng,"Low power digital baseband for impulse radio ultra-wideband transceiver," Circuits, Systems and Signal Processing, vol. 31, no. 1, pp. 223-235, Feb. 2012.
16. S. Diao, Y. Zheng, Y. Gao, S. J. Cheng, X. Yuan, M. Je, C. H. Heng, "A 50Mbps CMOS QPSK/O-QPSK Transmitter Employing Injection Locking for Direct Modulation," IEEE Trans. on Microwave Theory and Techniques, vol. 60, no. 1, pp.120-130, Jan. 2012.
17. M. Izad, C. H. Heng, "A Pulse Shaping Technique for Spur Suppression in Injection-Locked Synthesizers," IEEE J. of Solid-State Circuits, vol. 47, pp.652-664, Mar. 2012.
18. I. M. Darmayuda, Y. Gao, M. T. Tan, S. J. Cheng, Y. Zheng, M. Je, C. H. Heng, "A self-powered power conditioning IC for piezoelectric energy harvesting from short duration vibrations," IEEE Trans. on Circuits and Systems II, vol. 59, pp. 578-582, Sep. 2012.
19. J. Tan, C. H. Heng, Y. Lian, "Design of Efficient Class-E Power Amplifiers for Short-Distance Communications," IEEE Trans. on Circuits and Systems I, vol. 59, pp. 2210-2220, Oct. 2012.
20. L. Wang, Y. Lian, C. H. Heng, "3~5GHz 4-channel UWB beamforming transmitter with 1-degree phase resolution through calibrated vernier delay line in 0.13-um CMOS," IEEE J. of Solid-State Circuits, vol. 47, pp. 3145-3159, Dec. 2012. **(Invited)**
21. L. Zhou, M. Annamalai, J. Koh, M. Je, L. Yao, and C. H. Heng, "A crystal-less temperature independent reconfigurable transmitter targeting for

high temperature wireless acoustic telemetry applications," IEEE Trans. on Circuits and Systems II, pp. 542-546, Sep. 2013.
22. Y. Gao, S. J. Cheng, W. D. Toh, Y. S. Kwok, K. C. Tan, X. Chen, W. M. Mok, H. H. Win, B. Zhao, S. Diao, C. Alper, Y. Zheng, S. Sun, M. Je, and

C. H. Heng, "An asymmetrical QPSK/OOK transceiver SoC and 15:1 JPEG encoder IC for multifunction wireless capsule endoscopy," IEEE J. of Solid-State Circuits, pp. 2717-2733, Nov. 2013.**(Invited)**
23. J. Tan, W. S. Liew, C. H. Heng, and Y. Lian, "A 2.4 GHz ULP Reconfigurable Asymmetric Transceiver for Single-Chip Wireless Neural Recording IC," IEEE Trans. on BioCAS, vol. 8, no. 4, pp. 497-509, Aug. 2014.
24. L. Wang, C. H. Heng, Y. Lian, "A Sub-GHz Mostly Digital Impulse Radio UWB Transceiver for Wireless Body Sensor Networks," IEEE JETCAS, vol. 4,

no. 3, pp. 344-353, Sep. 2014.

25. Y. Zheng, Y. Zhu, C. W. Ang, Y. Gao, and C. H. Heng, "A 3.54 nJ/bit-RX, 0.671 nJ/bit-TX Burst Mode Super-Regenerative UWB Transceiver in 0.18-um CMOS," IEEE Trans. on Circuits and Systems I, vol. 61, no. 8, pp. 2473-2481, Aug. 2014.
26. X. Liu, M. Izad, L. Yao, and C. H. Heng, "A 13-pJ/bit 900-MHz QPSK/16-QAM transmitter with band shaping for biomedical application," IEEE J. of
Solid-State Circuits, vol. 49, no. 11, pp. 2408-2421, Nov. 2014.**(Invited)**
27. L. Zhou, M. Annamalai, M. Je, L. Yao, C. H. Heng, "A fully integrated temperature-independent reconfigurable acoustic transmitter with digital

on-chip resistor temperature coefficient calibration for oil drilling application," IEEE Trans. on Circuits and Systems II, vol. 62, no. 6, pp. 810-813, Jun. 2015.
28. J. Nankoo and C. H. Heng, "A digitally-assisted error compensation grouping method for element matching improvement in data converters," Analog
Integrated Circuits and Signal Processing,vol. 83, no. 2, pp. 231-242, May 2015.
29. C. J. Deepu, X. Zhang, C. H. Heng, and Y. Lian, "A 3-lead ECG-on-chip with QRS detection and lossless compression for wireless sensors," IEEE Trans. on Circuits and Systems II, no. 12, pp. 1151-1155, Dec. 2016.
30. C. J. Deepu, C. H. Heng, Y. Lian, "A hybrid data compression scheme for power reduction in wireless sensors for IoT," IEEE Trans. on BioCAS, pp. 1-10, Nov. 2016.
31. K. H. Teng, T. Wu, X. Liu, Z. Yang, C. H. Heng, "A 400MHz wireless neural signal processing IC with 625x on-chip data reduction and reconfigurable BFSK/QPSK transmitter based on sequential injection locking," IEEE. Trans on BioCAS, 547-557, May 2017.
32. K. H. Teng and C. H. Heng, "A 370pJ/b multi-channel BFSK/QPSK transmitter using injection-locked fractional-N synthesizer for wireless biotelemetry devices," IEEE J. of Solid-State Circuits, pp. 867-880, Jan. 2017.

Conference Papers

1. C. H. Heng and B. S. Song, "1.8GHz CMOS fractional-N frequency synthesizer with randomized multiphase VCO," Proc. CICC, pp. 427-430, May 2002.
2. T. Cho, D. Kang, S. Dow, C. H. Heng, B. S. Song, "2.4GHz dual-mode 0.18um CMOS transceiver for Bluetooth and 802.11b," ISSCC Dig. Tech. Papers,
Feb. 2003, pp. 88-89.
3. C. H. Heng, M. Gupta, S. Lee, D. Kang, B. S. Song, "CMOS TV tuner/demodulator IC with digital image rejection," ISSCC Dig. Tech. Papers, pp. 432-433, Feb. 2005.
4. C. W. Ang, Y. Zheng, C. H. Heng, "A multi-band CMOS low noise amplifier for multi-standard wireless receivers," Proc. ISCAS, pp., May 2007.
5. S. H. Teh, C. H. Heng, A. Tay, "Device performance-based OPC for optimal circuit performance and mask cost reduction," SPIE Proceedings, Vol. 6925, Mar. 2008.
6. S. H. Teh, C. H. Heng, A. Tay, "Design-process integration for performance-based OPC framework," Proc. of 45th DAC, pp. 522-527, Jun. 2008.
7. Y. Gao, Y. Zheng, C. H. Heng, "Low-power CMOS RF front-end for non-coherent UWB-IR receiver," Proc. ESSCIRC, pp. 386-389, Sept. 2008.
8. A. Bansal, Y. Zheng, C. H. Heng, "2GHz CMOS noise cancellation VCO," Proc. ASSCC, pp. 461-464, Nov. 2008.
9. S. J. Cheng, Y. Zheng, C. H. Heng, "1.1 to 1.9GHz CMOS VCO for Tuner Application with Resistively Tuned Variable Inductor," Proc. RFIC, pp. 87-90, June 2009.
10. S. Diao, Y. Zheng, Y. Gao, X. Yuan, C. H. Heng, "3-5GHz IR-UWB timed array transmitter in 0.18um CMOS," Proc. ASSCC, pp. 365-368, Nov. 2009.
11. D. D. Pham, J. Brinkhoff, K. Kang, C. W. Ang, F. Lin, C. H. Heng, "Feedforward technique for offset cancellation in broadband differential amplifiers," Proc. ISIC, pp. 429-432, Dec. 2009.
12. K. Kang, D. D. Pham, J. Brinkhoff, C. H. Heng, F. Lin, X. Yuan, "A power efficient 60GHz 90nm CMOS OOK receiver with an on-chip antenna," Proc.
RFIT, pp. 36-39, Dec. 2009.
13. C. H. Heng, A. Bansal, S. J. Cheng, "Techniques for improving CMOS VCO performance," Proc. RFIT, pp. 182-186, Dec. 2009. **(Invited)**
14. Y. Zheng, S. Diao, C. W. Ang, Y. Gao, F. C. Choong, Z. Cheng, X. Liu, Y. S. Wang, X. Yuan, C. H. Heng, "A 0.92/5.3nJ/b UWB impulse radio SoC for communication and localization," ISSCC Dig. Tech. Papers, pp. 230-231, Feb. 2010.
15. Y. Zheng, Y. Gao, S. Diao, C. W. Ang, D. Han, and C. H. Heng, "Advance on pulse-based UWB integrated transceiver circuits and systems: Invited

paper," Proc. ICUWB, pp. 1-4, Sep. 2010.
16. J. Brinkhoff, F. Lin, K. Kang, D-D Pham, and C. H. Heng, "A 60 GHz heterodyne quadrature transmitter with a new simplified architecture in 90nm
CMOS," Proc. ASSCC, pp. 293-296, Nov. 2010.
17. S. Diao, Y. Zheng, Y. Gao, X. Yuan, M. Je, and C. H. Heng, "A 5.9mW 50Mbps CMOS QPSK/O-QPSK transmitter employing injection locking for direct

modulation," Proc. ASSCC, pp. 37-40, Nov. 2010.
18. S. Diao, Y. Zheng, Y. Gao, C. H. Heng, M. Je, "A 7.2mW 15Mbps ASK CMOS transmitter for ingestible capsure endoscopy," Proc. APCCAS, pp. 512-515, Dec. 2010.
19. Y. Gao, Y. Zheng, S. Diao, Y. Zhu, C. H. Heng, "An Integrated beamformer for IR-UWB receiver in 0.18-um CMOS," Proc. ISCAS, pp.1548-1551, May 2011.
20. W. D. Toh, B. Zhao, Y. Gao, Y. Zheng, M. Je, C. H. Heng, "A Low Power JPEG Image Compression IC for Wireless Ingestible Endoscopy," Proc. ISIC,
pp. 396-399, Dec. 2011.
21. A. Cabuk, Y. Gao, S. Diao, Y. Zheng, M. Je, C. H. Heng,"Low-Power Wireless Receivers for Healthcare Applications," Proc. ISIC, pp. 356-359, Dec. 2011.
22. L. Wang, Y. X. Guo, Y. Lian, C. H. Heng, "3-to-5GHz 4-Channel UWB Beamforming Transmitter with 1 deg Phase Resolution through Calibrated Vernier Delay Line in 0.13um CMOS," ISSCC Tech. Dig. Paper, pp. 444-445, Feb. 2012.
23. M. Izad and C. H. Heng, "A 17pJ/bit 915MHz 8PSK/O-QPSK transmitter for high data rate biomedical applications," Proc. CICC, pp. 1-4, Sep. 2012.
(**Intel/Analog Devices/Catalyst Foundation CICC Student Scholarship Award** recipient for being one of the highest rated student paper, **6th TSMC OSR Award Commendation Prize**)
24. Y. Gao, S. J. Cheng, W. D. Toh, Y. S. Kwok, K. C. Tan, X. Chen, W. M. Mok, B. Zhao, S. Diao, C. Alper, Y. Zheng, S. Sun, M. Je, C. H. Heng, "A

QPSK/OOK transceiver SoC and JPEG encoder chipset for multifunction wireless capsule endoscope," Proc. ASSCC, pp. 341-344, Nov. 2012.
25. Y. Gao, X. Liu, Y. Zheng, S. Diao, W. Toh, Y. Wang, B. Zhao, M. Je, C. H. Heng, "A low power interference robust IR-UWB transceiver SoC for WBAN applications," Proc. RFIT, pp. 153-155, Nov. 2012.
26. S. J. Cheng, Y. Gao, W. D. Toh, Y. Zheng, M. Je, C. H. Heng, "A 110pJ/b multi-channel FSK/GMSK/QPSK/pi/4-DQPSK transmitter with phase-interpolated dual-injection DLL-based synthesizer employing hybrid FIR," ISSCC Dig. Tech. Papers, pp. 450-451, Feb. 2013.
27. C. H. Heng, Y. Gao, M. Izad, S. Diao, S. J. Cheng, Y. Zheng and M. Je, "Energy efficient transmitters for high data rate biomedical applications," IEEE International Wireless Symposium, pp. 1-4, Apr. 2013. **(Invited)**
28. X. Liu, M. Izad, L. Yao, and C. H. Heng, "A 13-pJ/bit 900-MHz QPSK/16-QAM transmitter with band shaping for biomedical application," Proc. ASSCC, pp. 189-192, Nov. 2013.**(2013 ASSCC Student Design Contest Runner Up)**
29. L. Zhou, M. Annamalai, W. K. Han, L. Sutha, Y. L. Guan, M. Je, L. Yao, and C. H. Heng, "25 to 300 degree celcius 80bps acoustic transmitter based on crystal-less temperature-independent frequency reference with di

fferential modulation for drilling noise power cancellation," Proc. ASSCC
,
pp. 456-456, Nov. 2013.
30. Y. Gao, D. I. Made, S. J. Cheng, M. Je, C. H. Heng, "An energy-autono
mous piezoelectric energy harvester interface circuit with 0.3V startup
voltage," Proc. ASSCC, pp. 445-448, Nov. 2013.
31. S. Diao, Y. Wang, C. Wang, F. Lin, C. H. Heng, "VCO Design for Low-Po
wer, High-Efficiency Transmitter Applications," Proc. RFIT, pp. 1-4, Aug.

2014. **(Invited)**
32. L. Wang, Y. Lian and C. H. Heng, "A 1.44mm2 4-Channel UWB Beamforming
Receiver with Q-Compensation in 65nm CMOS," Proc. ASSCC, pp. 253-256,
Nov. 2014.
33. X. Liu, Y. Gao, W. D. Toh, S. J. Cheng, M. Je, and C. H. Heng, "A 103
pJ/bit Multi-channel Reconfigurable GMSK/PSK/16-QAM Transmitter with
Band-shaping," Proc. ASSCC, pp. 269-272, Nov. 2014.
34. L. Wang, C. H. Heng, and Y. Lian, "CMOS UWB Beamforming Radar System,
" ICECS, pp. 810-813, Dec. 2014.**(Invited)**
35. L. Wang, C. H. Heng, Y. Lian, "A sub GHz Mostly Digital BPSK IR UWB T
ransceiver," Proc. ISCAS, pp. 1242-1245, May 2015.
36. X. Meng, L. Zhou, F. Lin, and C. H. Heng, "390-640MHz Tunable Oscilla
tor based on Phase Interpolation with -120dBc/Hz in-band Noise," Proc.
CICC, pp. 1-4, Sep. 2015.
37. K. H.Teng, T. Wu, X. Liu, Z. Yang, and C. H. Heng, "A 400-MHz Wireles
s Neural Signal Processing IC with 625x on-Chip Data Reduction and
Reconfigurable BFSK/QPSK Transmitter Based on Sequential Injection Lockin
g," Proc. ASSCC, pp. 1-4, Nov. 2015.
38. K. Ali, F. Li, Y. H. Lua, C. H. Heng, "Compact spin transfer torque n
on-volatile flip flop design for power-gating architecture," Proc. APCCAS
,
pp. 119-122, Oct. 2016.
39. W. Mao, Y. Li, C. H. Heng, and Y. Lian, "Dynamic mapping method for s
tatic and dynamic performance improvement on current-steering digital-to-
analog converter," Proc. APCCAS, pp. 336-339, Oct. 2016.

Tutorials and Workshop

1. Biomedical Circuits and Systems Conference, "Energy efficient high dat
a rate
transmitters for biomedical applications," Nov. 2012.
2. International Wireless Symposium, "Reconfigurable energy efficient tra
nsmitter with

band-shaping and multi-channel support," Mar. 2015.

Book Chapter

1. Yuan Gao, Xin Liu, Yuanjin Zheng, Shengxi Diao, Weida Toh, Yisheng Wang, Bin Zhao, Minkyu Je and Chun-Huat Heng, "A Low Power Interference Robust
IR-UWB Transceiver SoC for WBAN Applications," Book Chapter in Ultra-Wideband and 60 GHz Communication for Biomedical Applications, pp. 23-44, 2014,
by Springer.
2. Chun-Huat Heng and Yuan Gao, "Energy Efficient High Data Rate Transmitter for Biomedical Applications," Book Chapter in Wireless Transceiver Circuits - System Perspectives and Circuit Aspects, pp. 371-401, 2015, by CRC Press.
3. Chun-Huat Heng, Yuan Gao, "Energy Efficient High Data Rate Transmitter for Biomedical Applications," Book Chapter in Wireless Medical Systems and Algorithms: Design and Applications, pp. 189-218, 2016, by CRC Press.

Research Students Supervised

Ph. D students

Cheng San Jeow (with DSO, Singapore)
Amit Bansal (with IME, Singapore)
Mehran Izad (with Qualcomm, San Diego)
John Serge Nankoo (with Schlumberger, Singapore)
Liu Xiayun (with Xilinx, Singapore)
Zhou Lianhong (with Global Foundries, Shanghai)
Teh Siew Hong (with Micron, Singapore)
Tan Jun (with Qualcomm, San Diego)
Wang Lei (with NXP, Singapore)
Teng Kok Hin (with HiSilicon, Singapore)
Tao Jingcheng
Luo Zhihong (Global Foundries, Singapore)
Luo Yuxuan

M. Eng students

Qiu Lin
Ang Chyuen Wei (with Micron, Singapore)
Toh Wei Da (with IME, Singapore)
Saisundar Sankaranarayanan (with IME, Singapore)
Li Yunming
Chan Pozan

Awards

Teaching

1. 2015 ATEA Honour Roll
2. 2014/2015 Faculty of Engineering Commendation List
3. 2013/2014 NUS Annual Teaching Excellence Award
4. 2013/2014 Faculty of Engineering Honours List
5. 2010/2011 NUS Annual Teaching Excellence Award
6. 2010/2011 Faculty of Engineering Honours List
7. 2009/2010 Faculty of Engineering Honours List
8. 2008/2009 Faculty of Engineering Innovative Teaching Award
9. 2008/2009 Faculty of Engineering Commendation List
10. 2007/2008 NUS Annual Teaching Excellence Award
11. 2007/2008 Faculty of Engineering Honours List
12. 2006/2007 Faculty of Engineering Commendation List

Teaching Courses

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EE6506 Advanced Integrated Circuit Design
EE5507 Analog IC Analysis and Design
EE4434 Integrated Circuit Technology, Design and Testing
EE2005 Electronics
EE2005E Electronics
EE2021 Devices and Circuits
EE2031 Circuits and Systems Design Lab
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