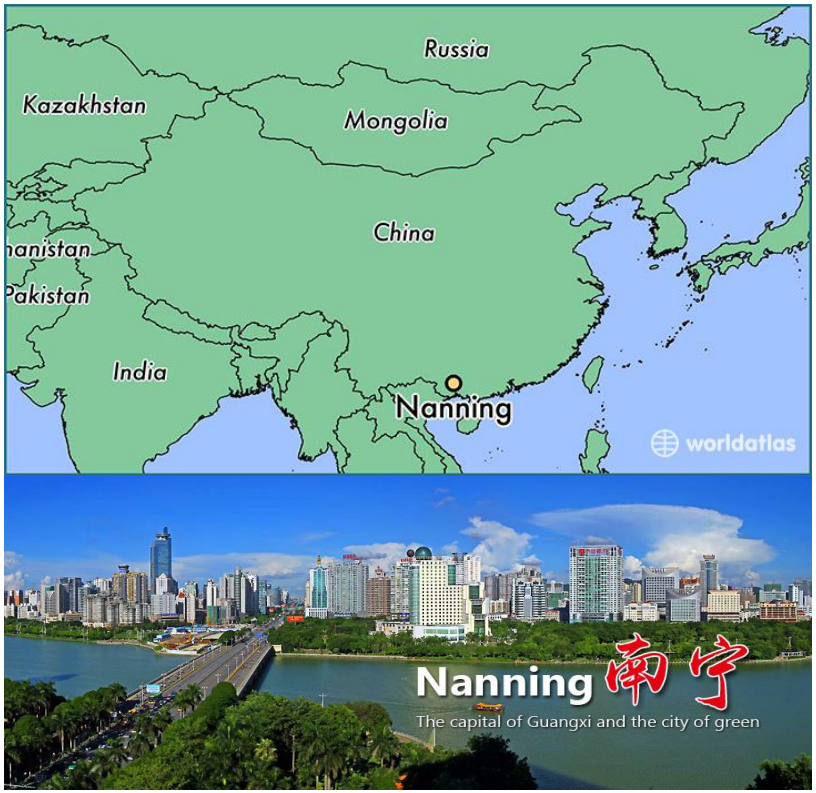
Low Power Sensing, Processing and Communication Systems

Klipsch School of Electrical and Computer Engineering

Wei Tang, Assistant Professor

About me (before NMSU)

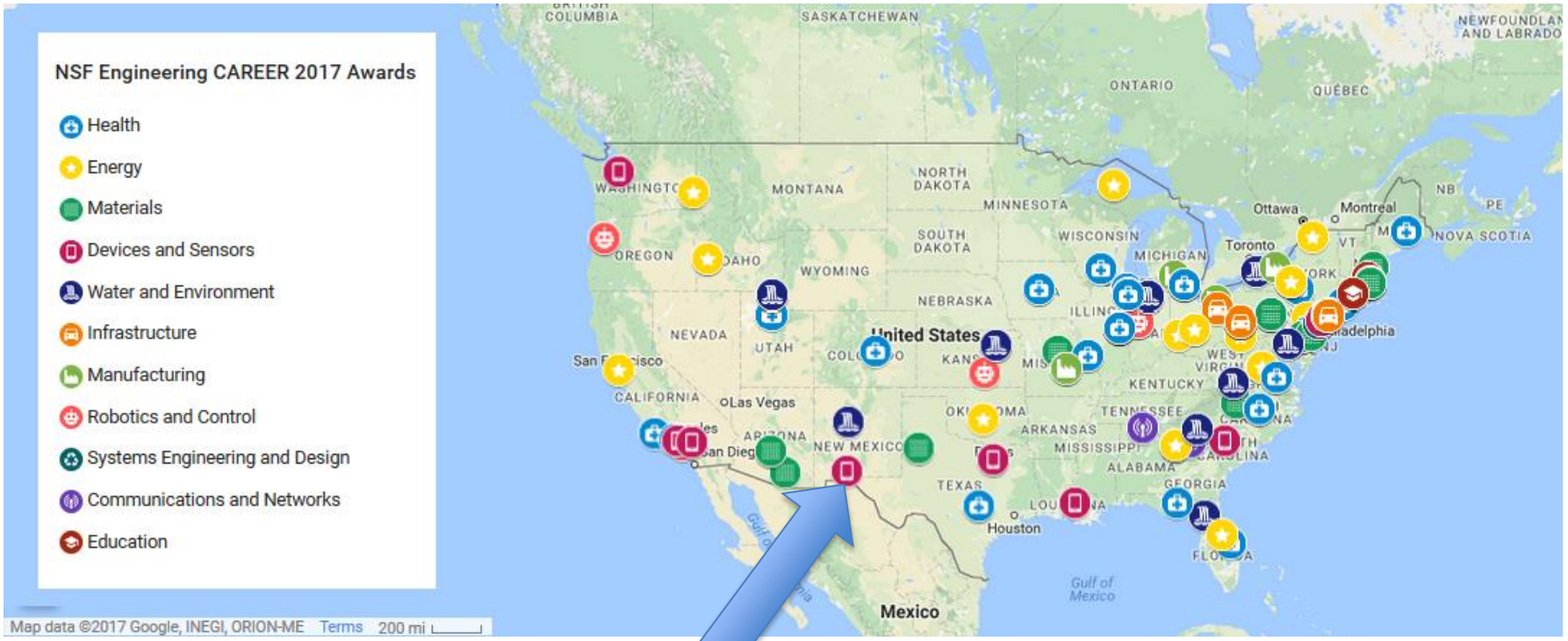


北京大学
PEKING UNIVERSITY

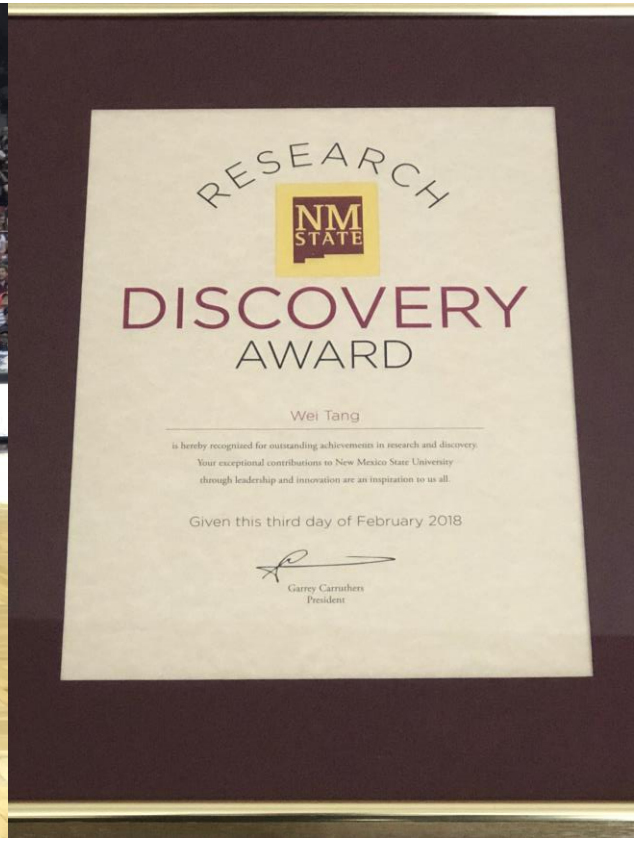
Yale University

About me (at NMSU)

National Science Foundation Faculty Early Career Awards
The most prestigious award in support of junior faculty: 156 awards in 2017



"Integrated Research and Education on Delta Sigma Based Digital Signal Processing Circuits for Low Power Intelligent Sensors" Wei Tang, New Mexico State University



NMSU News

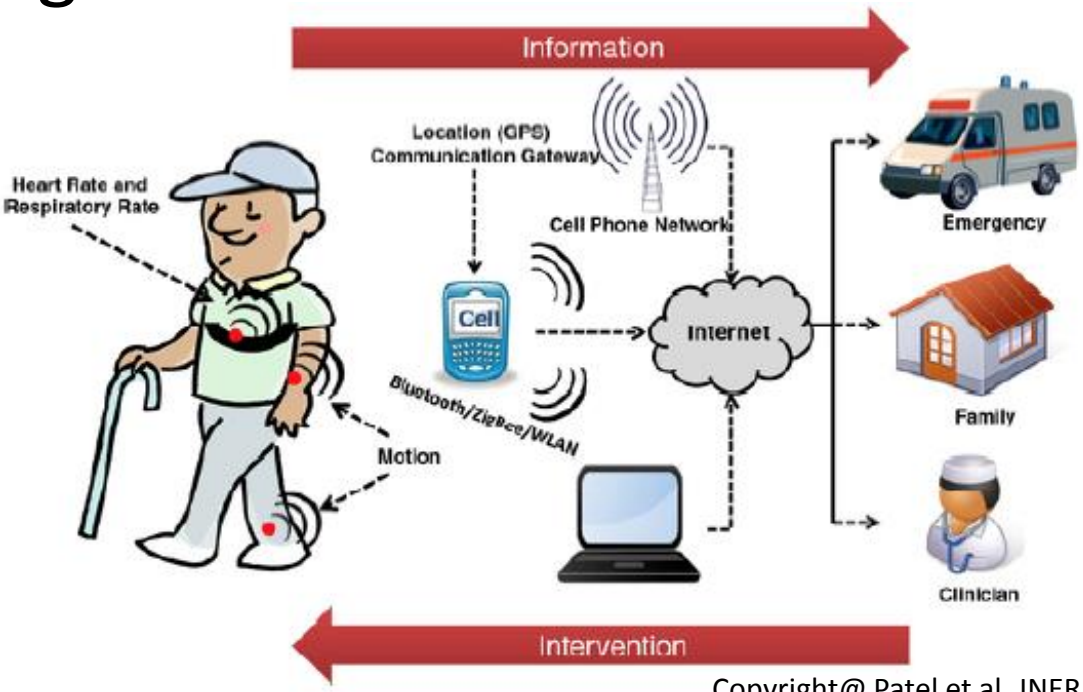
February 5 at 8:44am ·

At the Feb. 3 men's basketball game, Chancellor Garrey Carruthers presented Wei Tang, assistant professor in the Klipsch School of Electrical and Computer Engineering, with the Research Discovery award.

Background

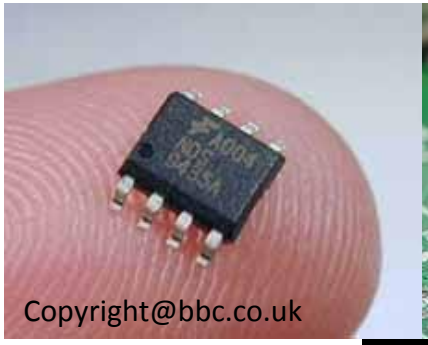
- Baby boomers retire: stress the Medicare system
- People living longer: complex health conditions
- Survivors from acute trauma: severe disabilities
- More people living alone + rural area

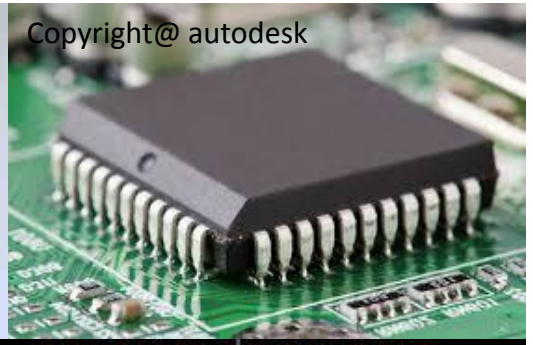
Remote health monitoring system based on wearable sensors

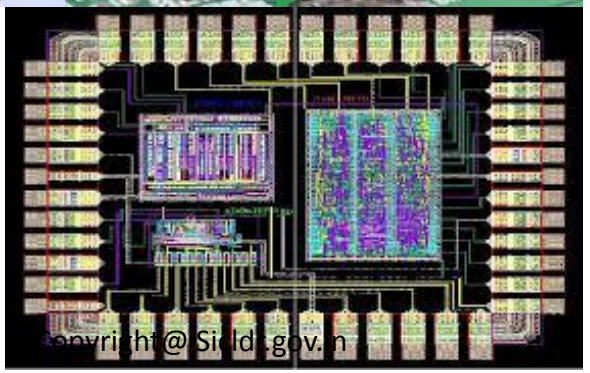


Research Expertise

- Technologies
  - Integrated Circuits
  - Low Power Design
- Applications
  - Miniaturized systems: portable, wearable, etc
  - Battery powered systems: longer battery lifetime
- Research directions
  - Sensing, Processing
  - Communication

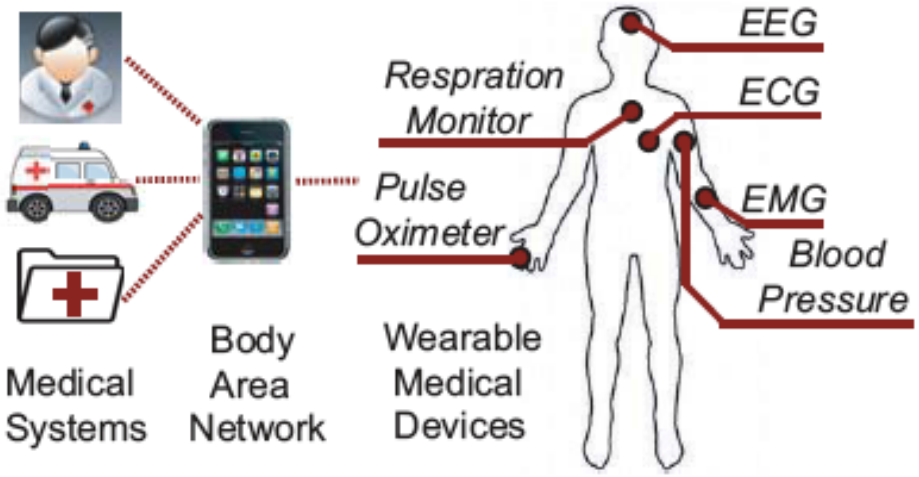






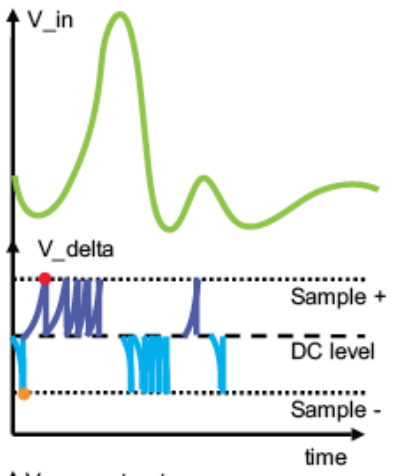
My research interest

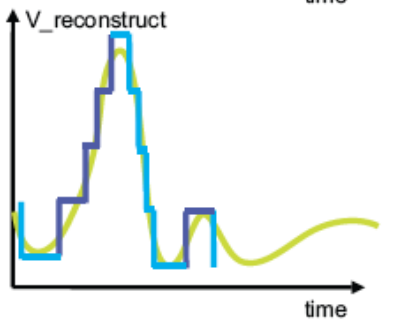
- Low Power Integrated Circuit Design
  - Analog, Digital, Mixed Signal, Radio Frequency
- Hardware Friendly Signal Processing Algorithm
  - Pixel level image processing
  - Alternative signal processing methods
  - Machine learning hardware
- Biomedical Sensors
  - Wearable devices
    Internet of Things
  - Heath care devices:
    elderly care



Research projects at NMSU (1/6)

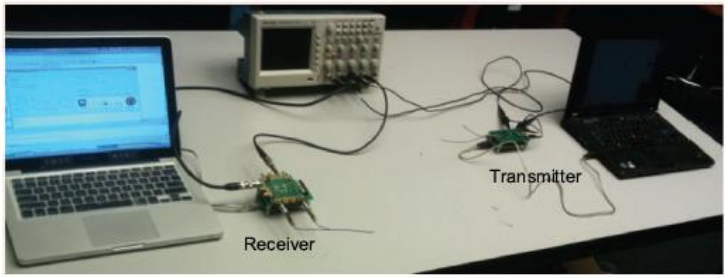
- Asynchronous Sensing and Wireless Communicatior
  - VLSI + Wireless (Wei Tang and Joerg Kliewer)
- Funded by NSF $400,000 (2014-2017)
- Paper:



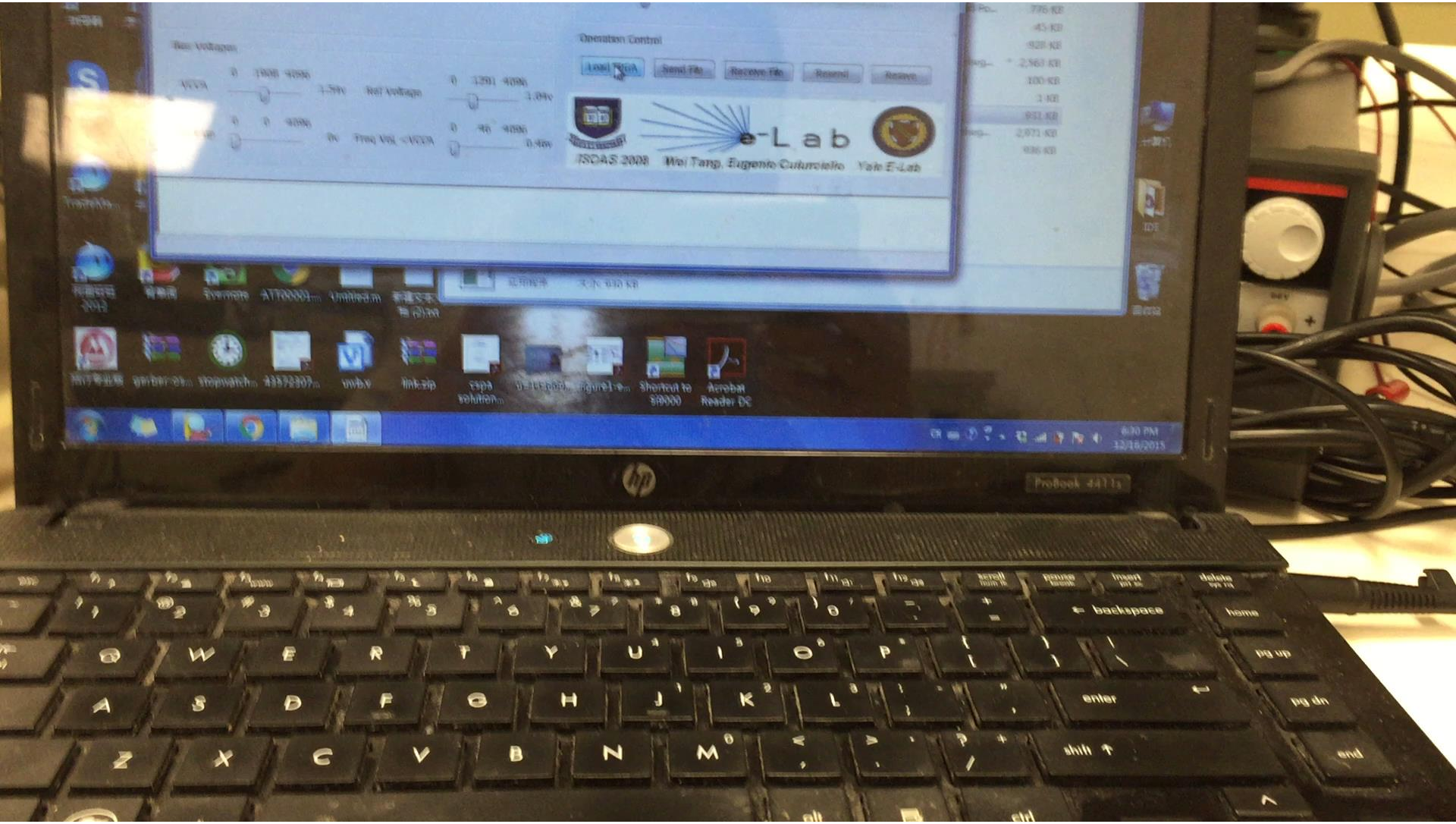


Qisong Hu; Chen Yi; Kliewer, Joerg; Tang, Wei, "Asynchronous communication for wireless sensors using ultra wideband impulse radio," in Circuits and Systems (MWSCAS), 2015 IEEE 58th International Midwest Symposium on , Aug. 2015

Qisong Hu, Xiaochen Tang, Wei Tang: “Integrated Asynchronous Ultra Wideband Impulse Radio with Automatic Clock and Data Recovery”. IEEE Microwave and Wireless Components Letters (MWCL). vol 27, no. 4, pp. 416-418, April 2017.

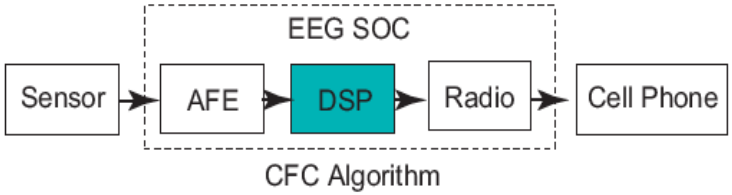


Research projects at NMSU (1/6)

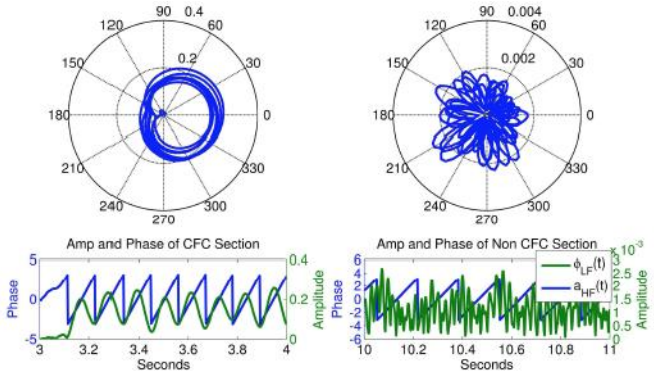


Research projects at NMSU (2/6)

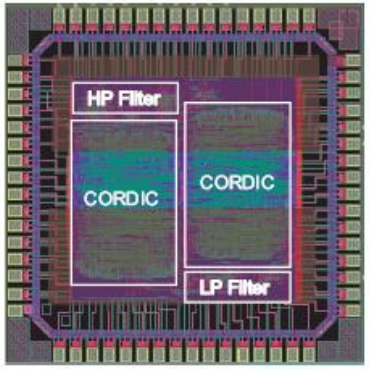
- Integrated Circuit for EEG and ECG
  - VLSI + DSP (Wei Tang and Chuck Creusere)
- NSF CAREER $500k part 1 (2017-2022)
- Papers:



Davis, P.; Creusere, C.D.; Wei Tang, "ASIC implementation of the cross frequency coupling algorithm for EEG signal processing," in Integrated Circuits (ISIC), 2014 14th International Symposium on , vol., no., pp.248-251, 10-12 Dec. 2014



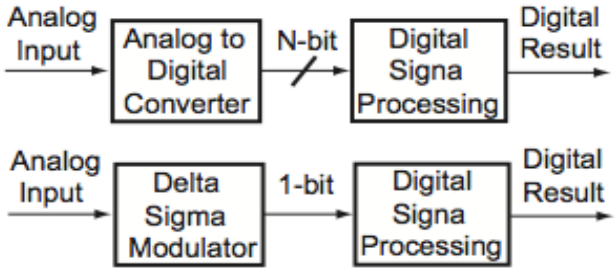
Davis, Philip; Creusere, Charles D.; Tang, Wei, "Window length effect on cross frequency coupling in an EEG processing circuit," in Circuits and Systems (MWSCAS), 2015 IEEE 58th International Midwest Symposium on , vol., no., pp.1-4, 2-5 Aug. 2015

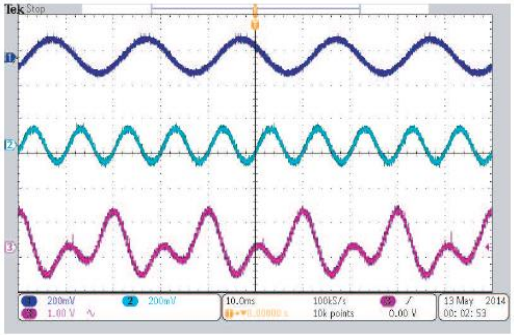


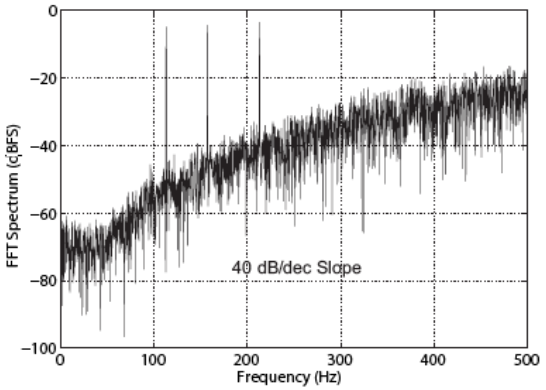
Xiaochen Tang, Qisong Hu, Wei Tang: “Delta-Sigma Encoder for Low Power Wireless Bio-sensors using Ultra Wideband Impulse Radio”. IEEE Transactions on Circuits and Systems – II Express Briefs (TCAS-II). vol 64, no. 7, pp. 747-751, July 2017.

Research projects at NMSU (3/6)

- Low power signal processing circuits using Delta Sigma Modulated bit-stream
  - Circuit + DSP (with Paul Furth and Djuro Zrillic)
- NSF CAREER $500k part 2 (2017-2022)
- Papers and Patent







Djuro Zrilic, Grozdan Petrovic, Wei Tang: “Novel Solutions of Delta-Sigma Based Rectifying Encoder”. IEEE Transactions on Circuits and Systems – II Express Briefs (TCAS-II). vol 64, no. 10. pp. 1242-1246, October 2017.

Yifei Liu, Paul M. Furth, Wei Tang. “Hardware-Efficient Delta Sigma-Based Digital Signal Processing Circuits for the Internet-of-Things”. MDPI Journal of Low Power Electronics and Applications, 234-256. May 2015.

Liu, Y., Tang, W. “A Delta Sigma based Finite Impulse Response Filter for EEG Signal Processing”. 2015 IEEE 58th International Midwest Symposium on Circuits and Systems (MWSCAS), August 2015.

Wei Tang and Yifei Liu, "NON-WEIGHTED DIGITAL SIGNAL PROCESSING FOR WEARABLE MEDICAL DEVICES,” United States Patent, 2016

Research projects at NMSU (4/6)

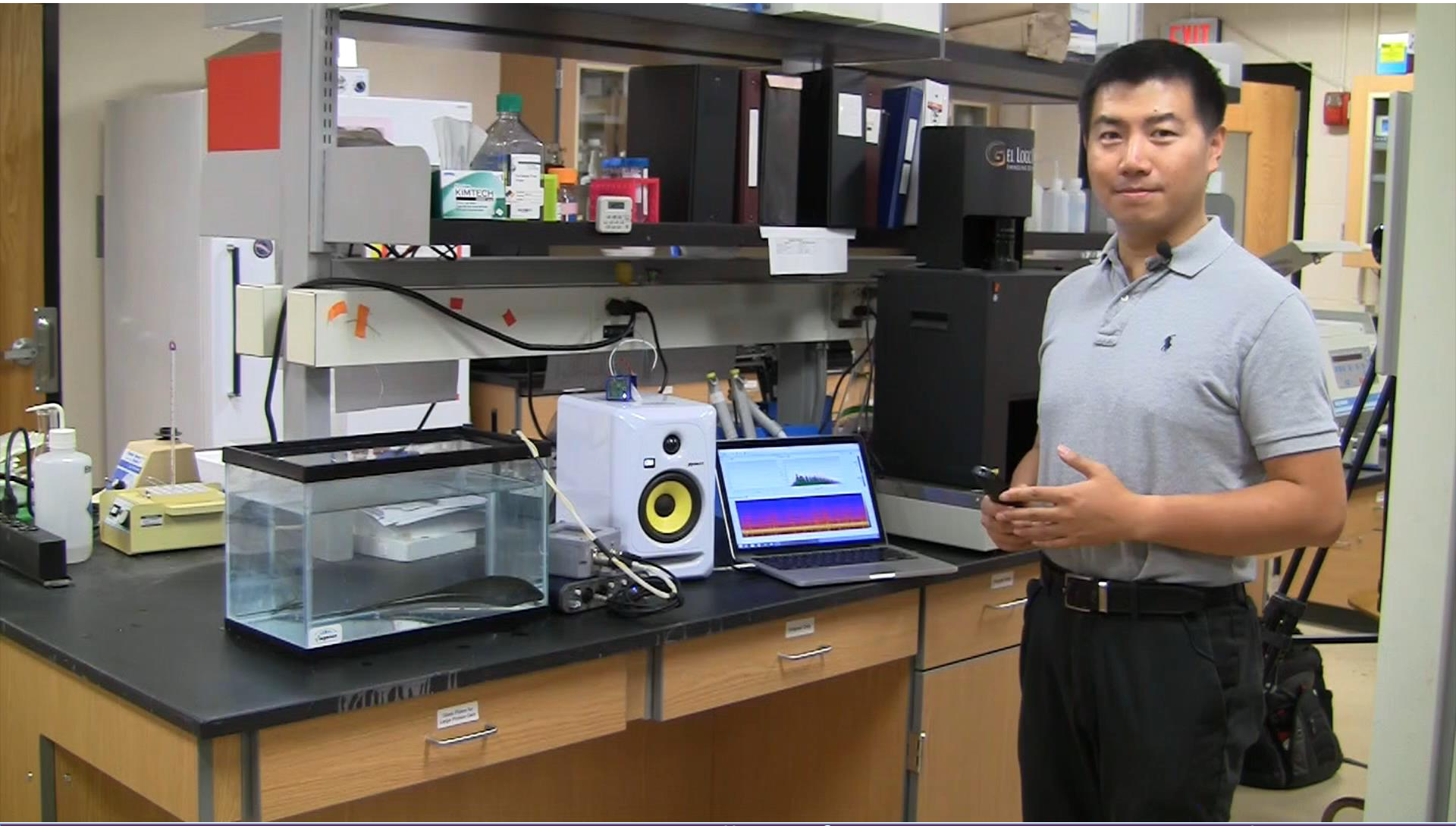
- Miniaturized sensors and stimulators for Fish Electric Organ Discharge
- EE (Wei Tang, Hong Huang) + CS (Jay Misra) + Biology (Graciela Unguez)
- Papers:

Harris, M.; Salazar, E.; Guth, R.; Nawathe, V.; Sharifi, M.; Wei Tang; Misra, S., "Wireless sensing framework for long-term measurements of electric organ discharge," in Biomedical Circuits and Systems Conference (BioCAS), 2013 IEEE , vol., no., pp.53-56, Oct. 31 2013-Nov. 2 2013

Al-Azzawi, H.; Hong Huang; Misra, S.; Wei Tang, "On using compressed sensing for efficient transmission & storage of electric organ discharge," in Circuits and Systems (ISCAS), 2014 IEEE International Symposium on , vol., no., pp.1616-1619, 1-5 June 2014

Unguez, G. A., Duran, C., Valles-Rosales, D. J., Harris, M., Salazar, E., McDowell, M., Tang, W. “3D-printed wearable backpack stimulator for chronic in vivo aquatic stimulation”. 2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), pp. 2147-2150. August 2015

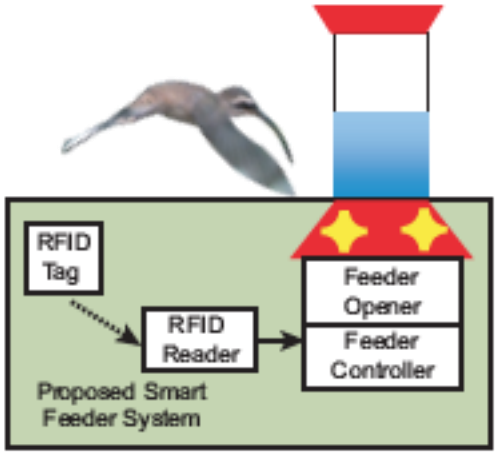
Research projects at NMSU (4/6)

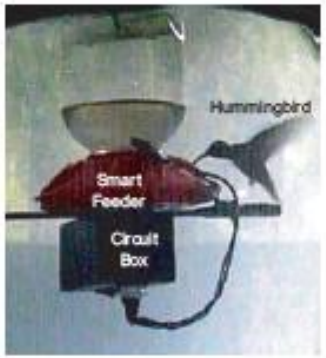


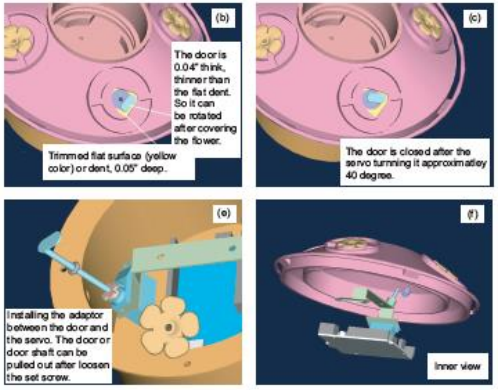
Research projects at NMSU (5/6)

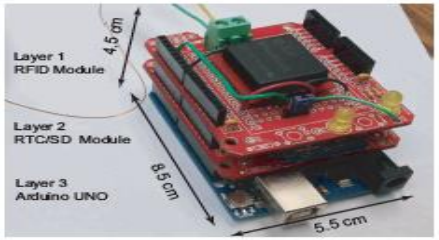
- RFID based Smart feeder for hummingbirds
- EE (Wei Tang) + Biology (Tim Wright)
- Paper:

Vicente Ibarra, Marcelo Araya-Salas, Yu-ping Tang, Charlie Park, Anthony Hyde, Timothy F. Wright, Wei Tang. “An RFID Based Smart Feeder for Hummingbirds”. MDPI Sensors, 15, 31751-31761. Dec 2015.



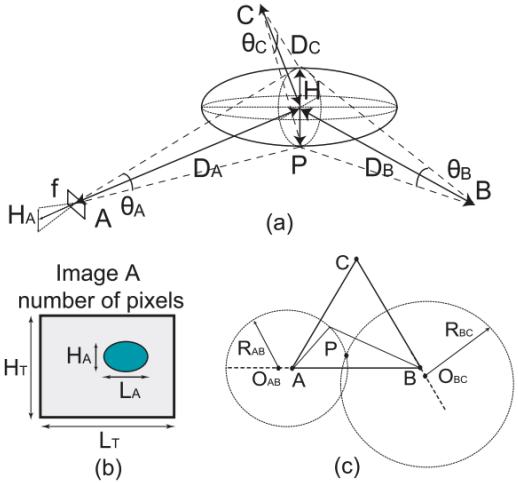






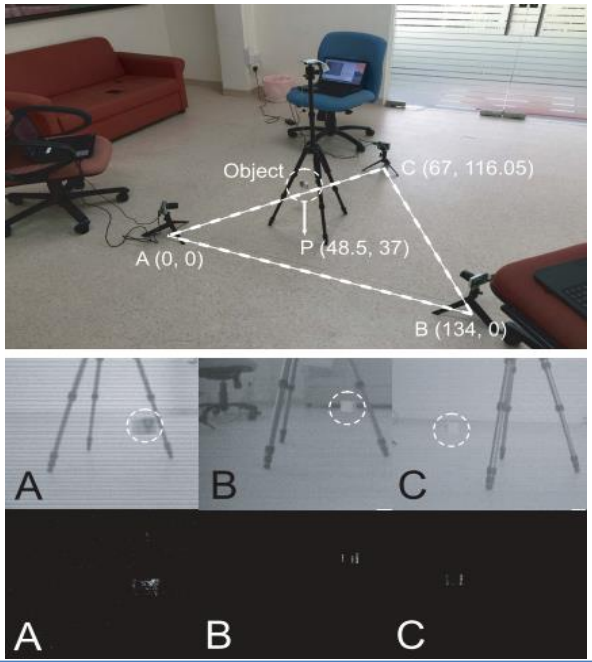
Research project at NMSU (6/6)

- Low power image and optical processing circuits
- ECE: Wei Tang and Deva Borah
- Papers



Yifei Liu, Xiaoyu Yu, Shoushun Chen, Wei Tang. “Object Localization and Size Measurement Using Networked Address Event Representation Imagers”. IEEE Sensors Journal, Vol. 16, no. 9, Page 2894-2895. May 2016

Hang Yu, Wei Tang, Menghan Guo, Shoushun Chen: “A Two-Step Prediction ADC Architecture for Integrated Low Power Image Sensors”. IEEE Transactions on Circuits and Systems – 1 Regular Paper (TCAS-I), vol. 64, no. 1, pp.50-60, January 2017.



Teaching

- New course developed at NMSU
  - EE 501 ECE Graduate Student Seminar
  - EE 512 ASIC Design
  - EE 514 Biosensor Electronics
  - EE 519 RF Microelectronics
  - EE 567 SOC Design
- Learning from students

Service

- Faculty advisor of ECE Graduate Student Organization
- Organizing ECE Research Seminars
- Outreach Activates
  - Host High and middle school visits
  - Visit High schools for outreach
  - PREP Program

NMSU PREP 2016

Summary

- Junior Faculty building career at NMSU
  - Aiming the big problems
  - Working with interdisciplinary collaborations
  - Learning and enjoying teaching
- Appreciate support from
  - Students
  - Colleagues
  - Leaders
  - Alumni

Thanks

Q and A