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## Shu-Wei Huang

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We study novel ultrafast nonlinear dynamics in photonic structures and incorporate the dynamics to enhance the device performances with focuses on sensing and imaging applications. We are also interested in functional integration of photonic devices with microfluidic, MEMS, photopolymer, and 2D materials to broaden the scope of chip-scale sensing and imaging devices.

Our fully renovated 1000-sqft lab has two narrow-linewidth tunable lasers (C/L bands), two Erbium fiber laser frequency combs, an Ytterbium fiber chirped pulse amplifier, and a full range of ultrashort pulse characterization tools. For sensitive optical measurements, we have two avalanche photodiodes, a balanced photodetector, a lock-in amplifier, and synchronization electronics. For data acquisition and image processing, our group has a GPU workstation for deep learning application and two laptops for instrument control and in-situ system diagnostics. For adaptive optics and wavefront control, our group has a reflective spatial light modulator based on the high-definition liquid crystal on silicon technology. Finally, we also have access to the cleanroom facilities in the Colorado Shared Instrumentation in Nanofabrication and Characterization, the NIST Gaithersburg Center for Nanoscale Science and Technology, and the Sandia Center for Integrated Nanotechnologies.

### **EDUCATION**

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**Massachusetts Institute of Technology (MIT)** **Cambridge, USA**  
PhD, Electrical Engineering & Computer Science, Aug 2012  
Thesis advisor: Franz X. Kärtner  
Thesis title: *High-Energy Sub-Cycle Optical Waveform Synthesizer*

**Massachusetts Institute of Technology (MIT)** **Cambridge, USA**  
MS, Electrical Engineering & Computer Science, Dec 2008  
Thesis advisor: James G. Fujimoto  
Thesis title: *New Technologies for Optical Coherence Microscopy*

**National Taiwan University** **Taipei, Taiwan**  
BSc, Electrical Engineering, Aug 2005

### **PROFESSIONAL EXPERIENCE**

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**Assistant Professor of Biomedical Engineering** **CU Boulder**  
Sep 2019 – present

**Assistant Professor of Electrical, Computer, & Energy Engineering** **CU Boulder**  
Sep 2017 – present

**Assistant Researcher (equivalent to Assistant Research Professor)** **UCLA**  
Aug 2014 – Aug 2017

### **HONORS**

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- Senior Member, OSA – The Optical Society
- Senior Member, SPIE – The International Society for Optical Engineering
- Faculty Early Career Development Award, National Science Foundation
- Collaborative Research Travel Award, Burroughs Wellcome Fund
- Young Investigator Award, Air Force Office of Scientific Research
- Jin-Au Kong Outstanding Doctoral Thesis, Massachusetts Institute of Technology

- 4 awarded and 4 provisional patents on ultrafast optics, nonlinear microscopy, nanophotonics, and precision measurements.

## **PROFESSIONAL ACTIVITIES**

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- Organizing committee: CIOP subcommittee on ultrafast and nonlinear phenomena (2020–present)
- Organizing committee: IEEE IPC subcommittee on optical microresonators and devices (2019–present)
- Organizing committee: CLEO subcommittee on nonlinear optical technologies (2016–2019)
- Vice chair: nonlinear optics technical group of The Optical Society (2018–present)
- Webinar chair: nonlinear optics technical group of The Optical Society (2015–2018)
- Volunteer editor: *Optics4Kids*, an educational program supported by The Optical Society
- Reviewer for >10 international refereed journals

## **POST-DOCTORAL, GRADUATE AND UNDERGRADUATE STUDENT ADVISING**

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### **Research scientists and post-doctoral research associates (current):**

1. Dr. Bowen Li, 01/2019 – present (Ph.D. Optics 2018)
2. Dr. Mingming Nie, 09/2018 – present (Ph.D. Optics 2018)

### **Graduate students (current):**

1. Jan Bartos, 08/2018 – present
2. Neeraj Prakash, 08/2018 – present
3. Yijun Xie, 08/2018 – present

### **Graduate students (alumni):**

1. Eugene Tsao (now at NIST, 2019 National Defense Science and Engineering Graduate Fellowship)
2. Rachel Westerkamp (now at Lockheed Martin, 2019 NSF Graduate Research Fellowship)

### **Undergraduate students (alumni):**

1. Jun Yan, 01/2020 – 10/2020 (2020 Undergraduate Research Opportunities Program)
2. Shida Zhang, 01/2019 – 12/2019 (2019 Undergraduate Research Opportunities Program)
3. Maxwell Adolphson, 01/2018 – 07/2019 (now a graduate student at Washington University in St. Louis)
4. Chutao Wei, 06/2018 – 08/2018 (now a graduate student at University of Colorado Boulder)

## **PUBLICATION LIST**

**total citations: 3465, h-index: 33, i-10 index: 50**

1. M. Nie, Y. Xie, and **S.-W. Huang**, Deterministic generation of parametrically driven dissipative Kerr soliton, *Nanophotonics*, submitted under review.
2. B. Li, J. Bartos, Y. Xie, and **S.-W. Huang**, Time-magnified photon counting with a 550-fs resolution, *Optica*, submitted under review.
3. A. K. Vinod, **S.-W. Huang**, J. Yang, *et al.*, Frequency microcomb stabilization via dual-microwave control, *Commun. Phys.*, accepted.
4. K. Jia, X. Wang, D. Kwon, [...], and **S.-W. Huang**, Photonic flywheel in a monolithic fiber resonator, *Phys. Rev. Lett.* **125**, 143902 (2020).
5. B. Yao, C. Qin, K. Jia, Q. Li, T. Tan, X. Wang, Y. Guo, **S.-W. Huang**, *et al.*, Electrically controllable laser frequency combs in graphene-fiber microresonators, *Light Sci. Appl.* **9**, 185 (2020).
6. C. Chen, Y. Xie, and **S.-W. Huang**, Nanophotonic optical gyroscope with sensitivity enhancement around “mirrored” exceptional points, *Opt. Commun.* **483**, 126674 (2021).
7. B. Li, S. Wang, Y. Wei, **S.-W. Huang**, and K. K.-Y. Wong, Temporal imaging for ultrafast spectral-temporal optical signal processing and characterization, *IEEE J. Sel. Top. Quantum Electron.* **27**, 7600613 (2020).

8. T. Tan, C. Peng, Z. Yuan, X. Xie, H. Liu, Z. Xie, **S.-W. Huang**, *et al.*, Predicting Kerr soliton combs in microresonators via deep neural networks, *J. Lightwave Technol.* **38**, 6591 (2020).
9. B. Li, J. Xing, Y. Xie, [...], and **S.-W. Huang**, Bidirectional mode-locked all-normal dispersion fiber laser, *Optica* **7**, 961 (2020).
10. M. Nie, and **S.-W. Huang**, Symbiotic quadratic solitons mode-locked non-degenerate dispersive optical parametric oscillators, *Opt. Lett.* **45**, 4184 (2020).
11. H. Zhou, X. Zhu, T. Gu, J. Wu, G. Deng, **S.-W. Huang**, *et al.*, Error-free data transmission through fast broadband all-optical modulation in graphene-silicon optoelectronics, *Appl. Phys. Lett.* **116**, 221106 (2020).
12. M. Nie, and **S.-W. Huang**, Quadratic solitons in singly resonant degenerate optical parametric oscillators, *Phys. Rev. Applied* **13**, 044046 (2020).
13. Y. Li, **S.-W. Huang\***, B. Li, *et al.*, Real-time transition dynamics and stability of chip-scale dispersion-managed frequency microcombs, *Light Sci. Appl.* **9**, 52 (2020). \*equal contribution and corresponding author
14. M. Nie, and **S.-W. Huang**, Quadratic soliton mode-locked degenerate optical parametric oscillator, *Opt. Lett.* **45**, 2311 (2020).
15. J. Yang, **S.-W. Huang**, Z. Xie, *et al.*, Coherent satellites in multi-spectral regenerative frequency microcombs, *Commun. Phys.* **3**, 27 (2020).
16. Z. Cao, B. Yao, C. Qin, R. Yang, Y. Guo, Y. Zhang, Y. Wu, L. Bi, Y. Chen, Z. Xie, G. Peng, **S.-W. Huang**, *et al.*, Biochemical sensing in graphene-enhanced microfiber resonators with individual molecule sensitivity and selectivity, *Light Sci. Appl.* **8**, 107 (2019).
17. M. Nie, J. Wang, and **S.-W. Huang**, Solid-state Mamyshv oscillators, *Photon. Res.* **7**, 1175 (2019).
18. H. Zhou, Y. Geng, W. Cui, **S.-W. Huang**, *et al.*, Soliton bursts and deterministic dissipative Kerr soliton generation in auxiliary-assisted microcavities, *Light Sci. Appl.* **8**, 50 (2019).
19. B. Yao, **S.-W. Huang\***, Y. Liu, *et al.*, Gate-tunable frequency combs in graphene-nitride microresonators, *Nature* **558**, 410 (2018). \*equal contribution and corresponding author
20. Y. Geng, X. Huang, W. Cui, Y. Ling, B. Xu, J. Zhang, X. Yi, B. Wu, **S.-W. Huang**, *et al.*, Terabit optical OFDM superchannel transmission via coherent carriers of a hybrid chip-scale soliton frequency comb, *Opt. Lett.* **43**, 2406 (2018).
21. C. Choi, J. Huang, H.-C. Cheng, H. Kim, A. K. Vinod, S.-H. Bae, V. O. Özçelik, R. Grassi, J. Chae, **S.-W. Huang**, *et al.*, Enhanced interlayer neutral excitons and trions in trilayer van der Waals heterostructures, *npj 2D Mater. Appl.* **2**, 30 (2018).
22. B. Yao, Y. Liu, **S.-W. Huang**, *et al.*, Broadband gate-tunable THz plasmons in graphene heterostructures, *Nature Photon.* **12**, 22 (2017).
23. **S.-W. Huang**, J. Yang, S.-H. Yang, *et al.*, Globally stable microresonator Turing pattern formation for coherent high-power THz radiation on-chip, *Phys. Rev. X* **7**, 041002 (2017).
24. B. Li, **S.-W. Huang\***, Y. Li, *et al.*, Panoramic-reconstruction temporal imaging for seamless measurements of slowly-evolved femtosecond pulse dynamics, *Nature Commun.* **8**, 61 (2017). \*equal contribution and corresponding author
25. H. Zhou, **S.-W. Huang\***, X. Li, *et al.*, Real-time dynamics and cross-correlation gating spectroscopy of free-carrier Drude slow-light solitons, *Light Sci. Appl.* **6**, e17008 (2017). \*equal contribution
26. **S.-W. Huang**, A. K. Vinod, J. Yang, *et al.*, Quasi-phase-matched multispectral Kerr frequency comb, *Opt. Lett.* **42**, 2110 (2017).
27. J. Wu, **S.-W. Huang\***, Y. Huang, *et al.*, Mesoscopic chaos mediated by Drude electron-hole plasma in silicon optomechanical oscillators, *Nature Commun.* **8**, 15570 (2017). \*equal contribution

28. B. Yao, C. Yu, Y. Wu, **S.-W. Huang**, *et al.*, Graphene-enhanced Brillouin optomechanical microresonator for ultrasensitive gas detection, *Nano Lett.* **17**, 4996 (2017).
29. B. C. Yao, Y. J. Rao, **S.-W. Huang**, *et al.*, Graphene Q-switched distributed feedback fiber lasers with narrow linewidth approaching the transform limit, *Opt. Express* **25**, 8202 (2017).
30. J. Lim, A. A. Savchenkov, A. B. Matsko, **S.-W. Huang**, *et al.*, Microresonator-stabilized extended cavity diode laser for supercavity frequency stabilization, *Opt. Lett.* **42**, 1249 (2017).
31. A. B. Matsko, A. A. Savchenkov, **S.-W. Huang**, *et al.*, Clustered frequency comb, *Opt. Lett.* **41**, 5102 (2016).
32. H. Zhou, M. L. Liao, **S.-W. Huang**, *et al.*, Six-wave mixing induced by free-carrier plasma in silicon nanowire waveguides, *Laser Photon. Rev.* **10**, 1054 (2016).
33. **S.-W. Huang**, J. Yang, M. Yu, *et al.*, A broadband chip-scale optical frequency synthesizer at  $2.7 \times 10^{-16}$  relative uncertainty, *Science Adv.* **2**, e1501489 (2016).
34. J. Lim, **S.-W. Huang**, A. Kumar, *et al.*, Stabilized chip-scale Kerr frequency comb via a high- $Q$  reference photonic microresonator, *Opt. Lett.* **41**, 3706 (2016).
35. **S.-W. Huang**, H. Liu, J. Yang, *et al.*, Smooth and flat phase-locked Kerr frequency comb generation by higher order mode suppression, *Sci. Rep.* **6**, 26255 (2016).
36. H. Zhou, **S.-W. Huang**, Y. Dong, *et al.*, Stability and intrinsic fluctuations of dissipative cavity solitons in Kerr frequency microcombs, *IEEE Photonics Journal* **7**, 3200113 (2015).
37. **S.-W. Huang**, J. Yang, J. Lim, *et al.*, A low-phase-noise 18 GHz Kerr frequency microcomb phase-locked over 65 THz, *Sci. Rep.* **5**, 13355 (2015).
38. **S.-W. Huang**, H. Zhou, J. Yang, *et al.*, Mode-locked ultrashort pulse generation from on-chip normal dispersion microresonators, *Phys. Rev. Lett.* **114**, 053901 (2015).
39. (INVITED) C. Manzoni, O. D. Mücke, G. Cirimi, S. Fang, J. Moses, **S.-W. Huang**, *et al.*, Coherent pulse synthesis: towards sub-cycle optical waveforms, *Laser Photon. Rev.* **9**, 129 (2015).
40. (INVITED) W. R. Huang, **S.-W. Huang**, E. Granados, *et al.*, Highly efficient terahertz pulse generation by optical rectification in cryogenically cooled lithium niobate, *J. Mod. Opt.* **62**, 1486 (2015, special issue on Physics with Strong THz Fields).
41. X. Luan, Y. Huang, Y. Li, J. F. McMillan, J. Zheng, **S.-W. Huang**, *et al.*, An integrated low phase noise radiation-pressure-driven optomechanical oscillator chipset, *Sci. Rep.* **4**, 6842 (2014).
42. H. Suchowski, P. R. Krogen, **S.-W. Huang**, *et al.*, Octave-spanning coherent mid-IR generation via adiabatic difference frequency conversion, *Opt. Express* **21**, 28892 (2013, special issue on Nonlinear Optics).
43. C.-J. Lai, G. Cirimi, K.-H. Hong, J. Moses, **S.-W. Huang**, *et al.*, Wavelength scaling of high harmonic generation close to the multiphoton ionization regime, *Phys. Rev. Lett.* **111**, 073901 (2013).
44. **S.-W. Huang**, E. Granados, W. R. Huang, *et al.*, High conversion efficiency, high energy THz pulses by optical rectification in cryogenically cooled lithium niobate, *Opt. Lett.* **38**, 796 (2013).
45. H.-W. Chen, J.K. Lim, **S.-W. Huang**, *et al.*, Optimization of femtosecond Yb-doped fiber amplifiers for high-quality pulse compression, *Opt. Express* **20**, 28672 (2012).
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47. G. Cirimi, C.-J. Lai, E. Granados, **S.-W. Huang**, *et al.*, Cut-off scaling of high-harmonic generation driven by a femtosecond visible optical parametric amplifier, *J. Phys. B: At. Mol. Opt. Phys.* **45**, 205601 (2012).
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49. C. Manzoni, **S.-W. Huang**, G. Cirimi, *et al.*, Coherent synthesis of ultra-broadband optical parametric amplifiers, *Opt. Lett.* **37**, 1880 (2012).
50. (INVITED) Y. Chen, **S.-W. Huang\***, C. Zhou, *et al.*, Improved detection sensitivity of line-scanning optical coherence microscopy, *IEEE J. Sel. Top. Quant. Electron.* **18**, 1094 (2012). \*equal contribution
51. (INVITED) **S.-W. Huang**, G. Cirimi, J. Moses, *et al.*, Optical waveform synthesizer and its application to high-harmonic generation, *J. Phys. B: At. Mol. Opt. Phys.* **45**, 074009 (2012).
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55. K.-H. Hong, J. T. Gopinath, D. Rand, A. M. Siddiqui, **S.-W. Huang**, *et al.*, High-energy, kHz-repetition-rate, ps cryogenic Yb:YAG chirped-pulse amplifier, *Opt. Lett.* **35**, 1752 (2010).
56. E. L. Falcao-Filho, C.-J. Lai, K.-H. Hong, V. M. Gkortsas, **S.-W. Huang**, *et al.*, Scaling of high-order harmonic efficiencies with visible wavelength drivers: A route to efficient extreme ultraviolet sources, *Appl. Phys. Lett.* **97**, 061107 (2010).
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61. P. M. Andrews, Y. Chen, **S.-W. Huang**, *et al.*, High-resolution optical coherence tomography imaging of the living kidney, *Lab. Invest.* **88**, 441 (2008).
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65. Y. Chen, **S.-W. Huang**, A. D. Aguirre, *et al.*, High-resolution line-scanning optical coherence microscopy, *Opt. Lett.* **32**, 1971 (2007).
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67. H. Mashimo, Y. Chen, **S.-W. Huang**, *et al.*, Endoscopic optical coherence tomography reveals Barrett's underneath squamous neo-epithelium after radiofrequency ablation, *Gastroenterology* **132**, A96 (2007).
68. **S.-W. Huang**, W.-J. Chen, and A.-H. Kung, Vibrational molecular modulation in hydrogen, *Phys. Rev. A* **74**, 063825 (2006).
69. **S.-W. Huang**, H.-Y. Mong, and C.-H. Lee, Super-resolution bright-field optical microscopy based on nanometer topographic contrast, *Microsc. Res. Tech.* **65**, 180 (2004).