

SHUAI SUN (孙率)

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RESEARCH FOCUS

Materials	2D Material (Graphene, ITO), Metamaterial (ENZ, EVL).
Devices	Atto-Joule Opto-Electronics Modulators, Detectors and Switches, Waveguides.
Optical Communication	Photonic, Plasmonic and Hybrid Photonic-Plasmonic Interconnects, Reconfigurable Optical Networks.
Optical Computing	Reconfigurable & Reversible Optical and Photonic Compute Engines, Neuromorphic Computing, Optical Residue Computing, Holistic Multi-Hierarchy Figure-of-Merit.
Optical Networks	Reconfigurable Network-on-Chip (NoC), Traffic Pattern Recognition.

EDUCATION

2015 - 18*	Ph.D.	The George Washington University , Washington DC, USA Electrical Engineering, Photonics Electronics and MEMS (3.86/4.00) Advisor: Dr. Volker J. Sorger
2012 - 14	MS	The George Washington University , Washington DC, USA Electrical Engineering, Power and Energy (3.85/4.00) Advisor: Dr. Robert Harrington
2008 - 12	BS	North China Electric Power University , Beijing, China Control Science and Engineering, Automation (3.00/4.00) Thesis advisor: Dr. Peng Guo. Title: "Wind Generator Gearbox Temperature Prediction based on Artificial Neural Network".

HORNORS & AWARDS

2017. 4	GWU - TCO	Innovation Competition, 2 nd prize in Physical Science (\$5,000)
2017. 4	GWU	Research Days, 1 st prize in Computational and Environmental Science Category (\$250)
2017. 2	SEAS - GWU	R&D Showcase, Innovation and Entrepreneurship Awards (\$2,000)
2017. 1	ECE - GWU	Graduate Research Assistantship and Fellowship (\$12,801)
2016. 9	ECE - GWU	Graduate Research Assistantship and Tuition Awards (\$13,238)
2016. 6	ECE - GWU	Graduate Research Assistantship and Tuition Awards (\$6,667)
2016. 4	GWU	Research Days, 2 nd prize in Engineering Category (\$250)

2016. 2	SEAS - GWU	2 nd prize of the Theoretical Research Awards (\$1,500) 2 nd place of the Entrepreneurship Awards (\$500)
2015. 9	ECE – GWU	Phillip & Temofel Sprawcew Endowment Scholarship (\$38,265)
2015. 4	ECE - GWU	GW Fellowships (\$4,500)

PROFESSIONAL SOFTWARES & SKILLS

Optical Components	Lumerical FDTD/Device/Mode/Interconnect, COMSOL, SILVACO
Circuit Design	Matlab, PSpice, Multisim, Simulink, Electronics
Hardware Design	FPGA, Cadence, Synopsys Design Vision, DSP Builder, Quartus
Image Processing	Mathematica, Origin, AutoCAD, Photoshop, Lightroom
Programming	Verilog HDL, C, C++

PROFESSIONAL SOCIETY MEMBERSHIPS & POSITION

Society	Member Since	Membership Type
Optical Society of America (OSA)	2015	Student Member
Society of Photographic Instrumentation Engineers (SPIE)	2015	Student Member
Institute of Electrical and Electronics Engineers (IEEE)	2017	Student Member
Chinses Association of Automation (CAA)	2011	Automation System Engineer

Society	Year	Position
OSA George Washington University Student Chapter	2015 - Present	Co-founder & Treasurer
SPIE George Washington University Student Chapter	2015 - Present	Co-founder & Treasurer
George Washington University Chinese Students and Scholars Association (CSSA)	2013-2014	Vice President

RESEARCH PROJECTS

- Hybrid Photonic Plasmonic Non-blocking Wide Spectrum WDM On-chip Router 06/2016 – Present
- Photonic data routing in optical networks overcomes the limitations of electronic routers with respect to data rate, latency and energy consumption, while suffering from dynamic power consumption, non-simultaneous usage of all possible wavelengths and large footprints.
 - Hybrid photonic plasmonic non-blocking broadband router is able to provide ultrafast response time (2 ps) and high-energy efficiency (82 fJ/bit) by hybridizing plasmonics with a photonic device, comparing with other MRR and MZI based photonic routers with microseconds-to-nanoseconds and picojoule levels, respectively.
 - Hybridizing plasmonics provides over a broadband 3-dB signal discrimination bandwidth exceeding 200 nm allowing for 140 Tbps theoretical noisy Shannon channel capacity. The high performance and scalability of the hybrid router are promising towards future large-scale multi-core optical networks requiring all-optical routing.

- Universal Figure-of-Merit CLEAR (Capability-to-Latency-Energy-Amount-Resistance) 01/2016 – 12/2016
- The CLEAR FOM includes all the related models to pre- and post-dict the evolution of computer systems. Comparing with other well-known FOM such as Moore's law, Koomey's law and Makimoto's FOM, CLEAR is proven to provide the most accurate tracks for both electronics and optical technologies while spanning multiple hierarchy levels in computer systems.
 - CLEAR bears the ability for smart computer systems via application-driven dynamic reconfigurability. Founded on fundamental physics principles, it can be regarded as the next Moore's law for the coming decades in data processing and computing in order to reveal the actual technology evolution.
- Reconfigurable Optical Computer (ROC) 10/2015 – Present
- The task of this project is to build a novel, programmable array of photonic R (and LC) components using nanoplasmonics technology in order to solve systems that can be described through differential equations and converted into electrical analogues, which can be regarded as a prototype of the Reconfigurable Optical Coprocessor (ROC).
 - Key insights include: a) to draw an analogue between optical and electrical characteristics of nanoscale pieces of matter, b) utilizing nanophotonics to demonstrate dramatic and efficient tuning of the permittivity of Indium Tin Oxide (ITO) via altering the free carrier concentration electrically, and c) deploying an array of photonics resistors, capacitors, and inductors, with programmable values and connectivity patterns, in order to solve partial differential equations directly in the analog domain.
- Dynamically Adaptive Hybrid Nano-plasmonic Networks on Chips (NoCs) 01/2015 – Present
- Main participants in and supported by this project (funded by **Air Force Office of Scientific Research**, award number FA9550-15-1-0447) and duty on exploring active plasmonic-enhanced circuits that perform beyond the limits of diffraction-limited photonics and mirroring architectures to develop a new class of high-performance network-on-chip (NoC) solutions for HPCs with orders of magnitude higher performance when bandwidth, latency, speed and cost are combined. It focus on exploiting synergies between plasmonic, photonic, and electronic components for the hybrid realization of NoC and the objectives are to minimized power consumption, footprint and cost, while maximizing data throughput and bit flow density.
- Electric Vehicle and Its Battery Technologies 12/2013
- Analyzed several EV developing factors, including the car market, policies, charging systems, and battery technologies. And battery technologies seem to be the main obstacle that blocks the road of EVs.
 - An analysis report about current EV battery barriers involving life span, charge time, safety and manufacturing cost. Lithium-air battery and ultra-capacitor will change the future of EVs.
- DE2-70 Board Guitar Effector Design (Music Man 2.0) 11/2013
- Designed color-detection-controlled music instrument using Altera DE2 developing board and a video camera. The camera was used to detect the number and position of green pixels in order to generate different sounds as set, and this function is called "Air Drum". In addition, Music Man 2.0 is able to control the output volume continuously, to select the output channels (Left/Right or Both), and to add echo, overload, distortion, and delay effect to the audio input.
- Wind Generator Gearbox Temperature Prediction based on ANN (Bachelor Thesis) 07/2012
- Using BP Artificial Neural Network with momentum algorithm to build the model of wind generator gearbox temperature and predict the change of temperature to avoid operation faults.

PUBLICATIONS

1. S. Sun, V. K. Narayana, I. Sarpkaya, J. Crandall, R. A. Soref, T. El-Ghazawi, V. J. Sorger, "Hybrid Photonic-Plasmonic Non-blocking Broadband 5x5 Router for Optical Networks". *Optics Express* (Under review).
2. V. K. Narayana, S. Sun, A. Mehrabian, V. J. Sorger, T. El-Ghazawi, "HyPPI NoC: Bringing Hybrid Plasmonics to an Opto-Electronic Network-on-Chip". *ICPP*, 2016. (Under review)
3. S. Sun, V. K. Narayana, T. El-Ghazawi, V. J. Sorger, "Moore's Law in CLEAR Light". *IEEE Spectrum*, 2016. (Under review)
4. S. Sun, V. Narayana, A. Mehrabian, T. El-Ghazawi, V. J. Sorger, "A Universal Multi-Hierarchy Figure-of-Merit for On-chip Computing and Communications", *Journal of Lightwave Technology* (Under review).
5. S. Sun, V. Narayana, T. El-Ghazawi, V. J. Sorger, "Chasing Moore's law with CLEAR", *CLEO 2017*. (Accepted)
6. V. Narayana, S. Sun, A. H. Badawy, V. Sorger and T. El-Ghazawi, "MorphoNoC: Exploring the Design Space of a Configurable Hybrid NoC using Nanophotonics". *Elsevier's Journal of Systems Architecture*, 2017.
7. K. Liu, S. Sun, A. Majumdar, V. J. Sorger, "Fundamental Scaling Laws in Nanophotonics". *Nature Scientific Reports*, 2016.
8. S. Sun, et al. "Low latency, area, and energy efficient Hybrid Photonic Plasmonic on-chip Interconnects (HyPPI)." *SPIE OPTO. International Society for Optics and Photonics*, 2016.
9. S. SUN, A. A. Badawy, V. Narayana, T. El-Ghazawi, and V. J. Sorger, "Bit Flow Density (BFD): An Effective Performance FOM for Optical On-chip Interconnects," in *Conference on Lasers and Electro-Optics, OSA Technical Digest*, paper JW2A.135.
10. S. Sun, and V. J. Sorger. "Photonic-Plasmonic Hybrid Interconnects: a Low-latency Energy and Footprint Efficient Link." *Integrated Photonics Research, Silicon and Nanophotonics. OSA*, 2015.
11. S. Sun, et al. "The Case for Hybrid Photonic Plasmonic Interconnects (HyPPI): A low Latency, Energy and Area Efficient On-chip Interconnects", *IEEE Photonics Journal*, Sep 2015.

PATENT FILED

1. "Hybrid Photonic Plasmonic Non-blocking Wide Spectrum WDM On-chip Router." S. Sun, V. J. Sorger, T. El-Ghazawi, V. Narayana, A.-H. Badawy (Submitted).
2. Provisional U.S. Patent: "Hybrid Photonic Plasmonic Interconnects (HyPPI) with intrinsic and extrinsic modulation options." S. Sun, V. J. Sorger, T. El-Ghazawi, V. Narayana, A.-H. Badawy (2015).
3. Provisional U.S. Patent: "The Reconfigurable Optical Coprocessor (ROC)." T. El-Ghazawi, V. Narayana, S. Sun, V. J. Sorger, A.-H. Badawy (2015).

Invited Talks & Presentations

CLEO 2017	San Jose, CA	05/2017
ECE Talks (The Spring GW/ECE Research Blitz)	Washington D.C.	04/2017
TCO Innovation Competition	Washington D.C.	04/2017
2017 GW Research Days	Washington D.C.	04/2017
2017 GW SEAS R&D Showcase	Washington D.C.	03/2017
2016 GW Research Days	Washington D.C.	04/2016
2016 GW SEAS R&D Showcase	Washington D.C.	03/2016
Photonic West: 2016	San Francisco, CA	02/2016

EMPLOYMENT & INTERNSHIPS HISTORY

George Washington University, **Graduate Research Assistant**, Washington D.C. 08/2015 – Present

- Research area includes: photonic-plasmonic hybrid interconnects, optical networks on-chip, analog optical computing, nano optical logic devices, novel materials, metamaterials, and optical processor.

The Sorger Group, **Web Master**, Washington, DC 04/2015 – Present

- Maintain website updated and professional, generate and revise pages and serve as the administrator.

Fastgrow Logistics Inc., **Electrical Engineer** (Telecommuting), City of Industry, CA 06/2014 – 12/2014

- Responsibilities include: Warehouse silo and belt electric equipment witness test planning and reporting, port equipment and leasing hopper car supervisions.

George Washington University, **Grader**, Washington D.C. 08/2013 – 12/2013

- Expanded students' knowledge of Telecommunication Security in electrical engineering field by providing related papers, assignments, and discussions regarding signal transmission and processing, encryption and decryption. Checked the assignments and lab reports.

State Grid Corporation of China, **R&D Intern**, Xuchang, China 06/2011 – 08/2011

- Participated in ECMS System Function Update of CCZ-8000C Digital Power Plant project and duty on modeling and testing of ECMS system modules, finished the first draft blueprint of Information Interaction System for every power equipment in the plant.
- Completed the debug task for two relay devices under minimum supervision.

XJ International Engineering Corp., **Technical Assistant Intern**, Xuchang, China 01/2011 – 02/2011

- Technical trainee in EPC Department of Kenya Athi River 81MW HFO Power Plant Project, duty involving electric equipment factory witness testing and port equipment supervisions.
- Organized business and technical conferences, translated project materials and technological manual.