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




Research
Interests

Wireless Power Transfer, Time/Spacetime Periodic metamaterials, Signal Integrity, Mathematical Foundations of Electrical Engineering, Computational Electrodynamics, Education of Engineering Electromagnetics.



Refereed Journal
Publications



- [1] **S. Y. Elnaggar** and G. N. Milford "Properties of translation operator and the solution of the eigenvalue and boundary value problems of arbitrary space-time periodic metamaterials". **Royal Society Open Science**, vol. 8, 2021. doi:10.1098/rsos.210367
- [2] **S. Y. Elnaggar** and G. N. Milford "Modelling Space-time Periodic Structures with Arbitrary Unit Cells Using Time Periodic Circuit Theory".  **IEEE Transactions on Antennas and Propagation**, vol. 68, 2020. doi:10.1109/TAP.2020.2985712
- [3] **S. Y. Elnaggar**, C. Saha, and Y. Antar "Wireless Power Transfer via Dielectric Loaded Multimoded Split Cavity Resonator". **Journal of Applied Physics**, vol. 126, 2019. doi:10.1063/1.5129280.
- [4] **S. Y. Elnaggar** and G. N. Milford. "Controlling Non-reciprocity using Enhanced Brillouin Scattering".  **IEEE Transactions on Antennas and Propagation**, vol. 66, no. 7, 2018. doi:10.1109/TAP.2018.2835305.
- [5] **S. Y. Elnaggar** and G. N. Milford "Three Wave Mixing as the Limit of Nonlinear Dynamics Theory for Nonlinear Transmission Line Type Metamaterials".  **IEEE Transactions on Antennas and Propagation**, vol. 66, no. 1, 2018. doi:10.1109/TAP.2017.2768577.
- [6] (Invited) S. M. Mattar, and **S. Y. Elnaggar**. "Modes and Fields of Two Stacked Dielectric Resonators in a Cavity of an Electron Paramagnetic Resonance Probe". **Applied Magnetic resonance**, 2017. doi:10.1007/s00723-017-0931-8
- [7] **S. Y. Elnaggar** and G. N. Milford "Description and Stability Analysis of Nonlinear Transmission Line Type Metamaterials using Nonlinear Dynamics Theory". **Journal of Applied Physics**, vol. 121, No. 12, 2017.
- [8] **S. Y. Elnaggar** "An Electromagnetic Induced Transparency-like Scheme for Wireless Power Transfer Using Dielectric Resonators". **Journal of Applied Physics**, vol. 121, No. 6, 2017. doi:10.1063/1.4975404.
- [9] **S. Y. Elnaggar**, R. J. Tervo, and S. M. Mattar. "Coupled Mode Theory in the presence of conductors".  **IEEE Transactions on Microwave Theory and Techniques**, vol. 63, no. 7, 2015. doi:10.1109/TMTT.2015.2432766 (one of the 50 most popular TMTT articles in July 2015).
- [10] **S. Y. Elnaggar**, R. J. Tervo, and S. M. Mattar. "Energy coupled mode theory for an arbitrary number of resonators".  **IEEE Transactions on Microwave Theory and Techniques**, vol. 63, no. 7, 2015. doi:10.1109/TMTT.2015.2434377 (one of the 50 most popular TMTT articles in Jul, Aug 2015).

- [11] **S. Y. Elnaggar**, R. J. Tervo, and S. M. Mattar. "General Expressions And Physical Origin Of The Coupling Coefficient Of Arbitrary Tuned Coupled Electromagnetic Resonators". **Journal of Applied Physics.**, vol. 118, 2015. doi:10.1063/1.4935634.
- [12] **S. Y. Elnaggar**, R. J. Tervo, and S. M. Mattar. "Optimal dielectric and cavity configurations for improving the efficiency of electron paramagnetic resonance probes". **Journal of Magnetic Resonance.** 245:50-57. 2014 doi:10.1016/j.jmr.2014.05.011.
- [13] **S. Y. Elnaggar**, R. J. Tervo, and S. M. Mattar. "General expressions for the Coupling Coefficient, Quality and Filling factors for a cavity with an insert using energy coupled mode theory". **Journal of Magnetic Resonance.** 242:57-62. 201 doi:http://dx.doi.org/10.1016/j.jmr.2014.01.018.
- [14] **S. Y. Elnaggar**, R. J. Tervo, and S. M. Mattar. "Coupled modes, frequencies and fields of a dielectric resonator and a cavity using coupled mode theory". **Journal of Magnetic Resonance.** 238:1-7. 2014. doi:http://dx.doi.org/10.1016/j.jmr.2013.10.016.
- [15] S. M. Mattar, and **S. Y. Elnaggar**. "Analysis of two stacked cylindrical dielectric resonators in a TE_{102} microwave cavity for magnetic resonance spectroscopy". **Journal of Magnetic Resonance.** 209:174–182. 2011. doi:http://dx.doi.org/10.1016/j.jmr.2011.01.004

To be Submitted

- [16] **S. Y. Elnaggar** , C. Saha, and Y. Antar "Analysis of a Wireless Power Transfer System Based on the Interaction of Very High Permittivity Dielectric Resonators with a Contained Aqueous Solution".

Conference Publications

- [17] K. Ghosal, **S. Y. Elnaggar**, C. Saha and Y. Antar "Highly Miniaturized Dielectric Layer Loaded Split Cavity Resonator for Wireless Power Transfer Applications", IEEE 19th India Council International Conference (INDICON), 2022 (*Accepted*).
- [18] **S. Y. Elnaggar** "Understanding S parameters in time domain and the application to Two X Automatic Fixture Removal of high speed interconnects", DesignCon 2022.
- [19] **S. Y. Elnaggar**, B. Kirkland, E. Frlan "Effect of Channel Scattering parameter Frequency Resolution and Maximum Frequency on the Simulation Accuracy of 112 Gb/s Links", DesignCon 2021. **Best Paper Award Finalist.**
- [20] C. Saha, **S. Y. Elnaggar** and Y. Antar "Impact of Losses in Wireless Power Transfer using DR Loaded Split Cavity Resonator". IEEE International Microwave and RF Conference, 2019.
- [21] **S. Y. Elnaggar** , C. Saha, and Y. Antar "An Electromagnetic Induced Transparency-like Scheme for Wireless Power Transfer in Contained Aqueous Solutions". *IEEE MTT-S Wireless Power Transfer Conference, Montreal, 2018.*
- [22] **S. Y. Elnaggar** , C. Saha, and Y. Antar "Effect of Detuning on the Performance of DR-Loaded Split Cavity Resonator Based Wireless Power Transfer Scheme". *IEEE MTT-S Wireless Power Transfer Conference, Montreal, 2018.*
- [23] G. N. Milford and **S. Y. Elnaggar**. "A Control Theory Approach to the Analysis of Propagation in Nonlinear Left and Right Handed Transmission Line Structures". The Fifteenth Australian Symposium on Antennas, Sydney, 2017.
- [24] **S. Y. Elnaggar** and G. N. Milford. "Forced Response of an arbitrary number of electromagnetic coupled resonators". *IEEE International Symposium on Antennas and Propagation/USNC-URSI, 2016.*
- [25] **S. Y. Elnaggar** and G. N. Milford. "Stability of Nonlinear Left Handed Transmission Lines Using Floquet Multipliers and Bifurcation Theory". *IEEE International Symposium on Antennas and Propagation/USNC-URSI, 2016.*

- [26] **S. Y. Elnaggar** and G. N. Milford. "Experimental and Numerical Analysis of Nonlinear Left Handed Transmission Lines using Three Wave Mixing". *Australian Microwave Symposium, Adelaide, 2016*.
- [27] **S. Y. Elnaggar** and G. N. Milford. "Analysis of Nonlinear Left-Handed Transmission Lines Using State Space Modelling". *International Symposium on Antennas and Propagation, Hobart, 2015*.
- [28] M. I. El-Banna and **S. Y. Elnaggar**. "A proposed information model for device simulation based on Semiconductor Wafer Representation". *IEEE 46th Midwest Symposium on Circuits and Systems, 2003*
doi:10.1109/MWSCAS.2003.1562538.
- [29] **S. Y. Elnaggar**. "Fixture Mismatch Correction for Wideband Measurements". IEEE AP-S/URSI 2023.
- [30] **S. Y. Elnaggar** and Y. M. Antar. "An Electrodynamics Solver for Moving Sources", URSI International Symposium on Electromagnetic Theory.

Submitted Conference Publications

Presentations

- [31] Analysis of Nonlinear Left-Handed Transmission Lines Using State Space Modelling, ISAP 2015, Hobart, Tasmania.
- [32] Investigation of the Electromagnetic Standing Waves in Doubly Stacked DR/TE₁₀₂ Resonator used for Enhanced Electron Paramagnetic Resonance Detection. *The 10th Atlantic Theoretical Chemistry Symposium*. July 17-19 (2009).
- [33] A proposed Information Model for Device Simulation Based on Semiconductor Wafer Representation, 46th Midwest Symp, Cairo.

Invited Talks

- [34] Effect of Channel Scattering parameter Frequency Resolution and Maximum Frequency on the Simulation Accuracy of 112 Gb/s Links, DesignCon Digital, October 2021.
- [35] Coupled-Mode Theory for RF and Microwave Resonators. *IEEE Student Branch*, University of New Brunswick, August 27, 2013

Technical Reports

- [36] Modelling of Dielectric-loaded Fabry Perot- Summary. Submitted to *ACERT, Cornell University, NY, USA*, March 2014.
- [37] Thermal Expansion using Michelson's interferometer. Submitted to the *The University of New Brunswick and C-Therm Technology*, September 2014.
- [38] Thermal Expansion using Michelson's interferometer-Phase II. Submitted to the *The University of New Brunswick and C-Therm Technology*, February 2015.

Industrial Standards

- [39] Ed Frlan, Mark Kimber, Bill Kirkland, **Sameh Elnaggar**, "Analysis of several 112 G VSR channels with updated recommendations", Optical Internetworking Forum (OIF), February 2020.
- [40] Mark Kimber, Ed Frlan, **Sameh Elnaggar**, Bill Kirkland, "Further analysis of synthesized 100G C2M short channels", IEEE 802.3ck Task Force Meeting, November 2019.
- [41] E. Frlan, B. Kirkland, **S. Y. Elnaggar** "Further Analysis of Juniper 5 mm/50 mm XSR die-to-die channels", Optical Internetworking Forum (OIF), May 2020.

Post-doctoral Experience



- Royal Military College of Canada **Sept. 2017 - current**
- Visiting Researcher.
- University of New South Wales, Canberra **Mar. 2017 - Mar. 2018**
- Research Associate (Adjunct Position).

University of New South Wales, Canberra

Mar. 2015 - Mar. 2017

- Lecturer A (PDF).
- Developed a nonlinear dynamics code to study Nonlinear Metamaterials (Solution of Nonlinear Differential Equations, Fourier Transform, Bifurcation Analysis, GUI).
- Carried out measurements to characterize microwave circuits (VNA, Spec. Analyzers, Scopes, Field Scanners).
- Proposed an efficient, long distance Wireless Power Transfer scheme based on the use of dielectric resonators.
- Developed a space-time Finite Difference Time Domain code, which describes space-time Metamaterials.
- A generalized Coupled Mode Theory to describe the behaviour of arbitrary coupled resonators.
- Software tools: MATLAB, HFSS, ADS.
- Hardware tools: VNA, Spectrum Analyzer, Oscilloscope, Field Scanner.
- Write Technical Documents, Conference and Journal Publications.

C-Therm Technologies and University of New Brunswick

Jan 2014 - Feb 2015

- Research Engineer.
- Design and Implementation of an ultra precise optical dilatometer based on Michelson's interferometry.
- Optical components selection, assembly and alignment (Lenses, Mirrors, Beam-splitters, Optical Tables, Lasers).
- Developed and Executed extensive testing plans in a controlled, vibration free environment.
- Evaluated the system parameters such as accuracy and repeatability according to the ASTM standard.
- Worked with Mechanical Engineers, Marketing and management groups to evaluate different requirements and constraints.
- Worked with Mechanical Engineers to design compact and stable packages.
- Developed image processing algorithms using C/C++, OpenCV and MATLAB (Multithreading, OOP, Nonlinear Fitting, 2D Fourier Transform, Filtering, Image Enhancing).
- Data Acquisition to collect, store and visualize system parameters.
- Detailed rigorous theoretical analysis.
- Prepared weekly progress reports, technical documents and operation manuals.
- Engaged in weekly meetings to discuss the progress of the project and other technical issues.
- The project was awarded the BCIP (Build in Canada Innovation Program) grant.

University of New Brunswick and Cornell University

Sept. 2013 - May 2014

- Post-doctoral Researcher.
- Model and analyze surface micro-resonators.
- Model and analyze a quasi-optical system consisting of transition horn and Fabry-Pérot cavity operating at 95GHz.
- Improve the quasi-optical system performance by adding dielectric resonators.
- Model, setup and analyze a 95GHz high-pressure variably coupled resonator consisting of a corrugated transmit/receive waveguide, coupling taper, beryllium/copper pressure cell block, sample volume, tuning taper and tuning mirror.

EgyScholar, 2016 - 2017

- Supervising and Mentoring Student doing research in Active Metamaterials.

Graduate Research Conference (GRC 2014), University of New Brunswick

- Judge.

Assisted in writing the NSERC-Engage Plus grant.

Prepared the technical details for the BCIP grant.

Reviewer

- IEEE- Transactions on Microwave Theory and Techniques.
- IET- Microwaves, Antennas and Propagation.
- AIP- Journal of Applied Physics.
- Review of Patent Applications.

Teaching Experience



Princeton Review, Fredericton, NB

Instructor

May 2012 - July 2014

- Instructor of MCAT: Medical College Admission Test, Physics section
 - Undergraduate level physics.
 - Course content: Electricity & Magnetism, Waves, Optics, Mechanics, Hydrostatics and Hydrodynamics.

Teaching Assistant

Jan. 2008 to May 2013

- Courses: Electromagnetics II, (ECE 3832) Systems & Control (ECE 3312), Electric circuits & electronics (ECE 2701), Computer Organization (ECE 3221), General Chemistry II (CHEM 1012), Data Communications & Networking (CMPE 3812), Digital Communications (ECE 4833), Electronics I (ECE 3211), Embedded System Design (CMPE 3232), Advanced Digital Systems (CMPE 4261), Industrial Control Systems (ECE 4323) and General Physical & Inorganic Chemistry (CHEM 1882).

Private Tutor

Mar. 2008 to May 2013

- Electromagnetics, Electronics, Circuits and Systems, Control theory, Calculus, Linear Algebra, Quantum mechanics, General Physics, Vector calculus and Vibration analysis.

Industrial Experience



Semtech Inc.

Jul. 2017-Current

- Senior Staff Engineer.
- IEEE and Optical Internetworking Forum (OIF) Very Short Range and Extra Short Range Channels Standard Meetings Contributions.
- Developed a fully fledged channel simulator.
- Broadband Devices Characterization (Deembedding, Vector Fitting, etc).
- Modelling and Simulating High Speed PCBs and Interfaces (LVDS, CML).
- Modelling SERDES devices (Feedforward, Continuous Time Linear and Decision Feedback Equalizers, Clock and Data Recovery, Laser Drivers, NRZ and PAM-4 signaling).
- Analysis of channels performance in the presence on noise, jitter and impairments.
- Multilayer, High Dense PCBs operating over a broadband frequency range (>50 GHz).
- Systems and Behavioural modelling (MATLAB, Simulink, SystemVue, IBIS-AMI).
- Theoretical analysis of broadband matching limitations.
- Packages Modelling and Simulations.
- Lasers Modelling.
- Preparing and Writing Application Notes.
- Time and Frequency domain of broadband Automatic Fixture removal algorithms.

European Egyptian Pharmaceutical Ind.

2003-2007

- Senior Control Engineer.
- Developed Data Acquisition network to monitor clean-rooms process variables. The Data Acquisition Boards (DABs) were created using AVR microcontrollers and programmed in C. DABs were attached to an RS485 bus to communicate with a Master PC. The code on the Master PC was developed using Visual Studio (Visual C++ and Visual Basic). Process variables were plotted in real time and stored in an Access database using SQL statements. The process variables can be viewed online via the internet using an ASP server.
- Design and Implementation of in house Ejection Control PCBs installed on various packaging machines. The design originally relied on 40XX CMOS family; then upgraded to more compact systems, which were built using Microchip and AVR microcontrollers. Programming Languages: Assembly and C.
- Commissioning and Start-up of various systems and machines (For e.g, Fire Alarm System, VOIP telephony network and Mobile Clean in Place equipment).
- Member of the Occupational Health and Safety committee.
- Design an auto-weight program to facilitate the dispatch of the raw materials.
- Maintenance of Production lines. This includes hardware troubleshooting, PLCs, process control, Packaging lines and Production reactors.
- Management tasks. This includes maintenance schedule plans, Writing Operation procedures.

- Calibration of process sensitive sensors and actuators: temperature, air flow, weight, humidity and differential pressure.
- Follow FDA-regulations.
- Maintenance of clean-rooms (class 100).

Amriya Pharmaceutical Ind.

2002-2003

- Installation of the European Egyptian Pharmaceutical Ind. Communication networks, the first VOIP network in Egypt.
- Design and implementation of Siemens NBX call processor dial plan.

Education



University of New Brunswick, Fredericton, NB

Ph.D., Electrical and Computer Engineering,

May 2013

- Thesis Topic: *Coupled Mode Theory for RF and microwave resonators.*
- Advisors: Professor Richard J. Tervo and Professor Saba M. Mattar.
- Area of Study: Electromagnetics.
- Courses: Industrial Controls, Decision Theoretic Agents, Topics in theoretical computations, Intro to General Relativity (AUD), Microwave Engineering (AUD).
- GPA: 4.3.

Diploma in University Teaching, D.U.T

December 2012

Atlantic Association for Research in the Mathematical Sciences (AARMS) August 2008

Computational Methods for PDEs (Math 6231)

- Course Instructor: Anne Bourlioux University of Montreal.
- Grade: A⁺.

Alexandria University, Alexandria, Egypt

M.S., Electrical and Computer Engineering,

July 2006

- Thesis Topic: *Modelling of Semiconductor devices for ICs and VLSI.*
- Advisor: Professor Mohamed I. Elbanna.
- Area of Study: Semiconductor devices.

B.Sc., Electrical and Computer Engineering,

June 2000

- Electrical specialization (emphasis on communication and electronics).
- Senior Project design title: *Hardware implementation of Artificial Neural Networks.*

University of New South Wales

Graduate Teaching Training Program

June 2016

- Completion with Merit.

Hardware and Software Skills



Printed Circuit Boards (PCB) design, layout and fabrication.

Optical components.

Microwave Measurement.

C/C++ Programming.

- Object-oriented, Low level programming, Data Structures and templates, GUI and API, COM objects, MFC (Microsoft Foundation Classes), Multi-threading and OPENCV.

Visual Basic, Pascal, MATLAB, MAPLE, Ansys-HFSS, CST Microwave Studio and Keysight-ADS, Cadence - Orcad., MEEP, Linux.

Assembly (8086, ATMEL AVR8, Microchip PIC8, NIOS II).

L^AT_EX.

Affiliations



Association of Professional Engineers & Geoscientists New Brunswick

- Registered Professional Engineer.

IEEE Ottawa, AP/MTT joint chapter

- Vice Chair.

Certificates & Training Courses



University of New South Wales

- Work & Safety.
- Ergonomics.

Certificate of accomplishment with distinction, Stanford University

- Quantum mechanics for Scientists and Engineers I, Dr. David Miller.

Certificate of accomplishment, Stanford University

- Quantum mechanics for Scientists and Engineers II, Dr. David Miller.

C-Therm

- Introduction to WHMIS (Workplace Hazardous Materials Information System).

Industry Canada

- Amateur Radio Operator Certificate- Full Access.

Lucent Technologies:

- Attendance certificate in GSM/UMTS mobile communications.

Mettler Toledo:

- Balances maintenance and controlling using the RS-232 interface.

Amriya Pharmaceutical Ind:

- Good Manufacturing Practice, GMP.
- ISO 9001; Quality Management.
- ISO 14001; Environmental Management.

Awards

- Best Paper Finalist, DesignCon 2021.
- Research and Teaching Assistant scholarship, ECE, UNB (2008-2013).
- UNB graduate Bursary (2009-2013).
- International differential fees scholarship (2008-2013).