Mahmoud Elfar

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EDUCATION

Duke University   Durham, NC | September 2022
Ph.D. in Electrical and Computer Engineering, Advisor: Miroslav Pajic
Dissertation: *Modeling and Design of Assured and Adaptive Cyber-Physical Systems*

Ain Shams University   Cairo, Egypt | June 2008
B.Sc. with Honors in Mechanical Engineering, GPA: 3.75, Class Rank: 2/110
Minor: Mechatronics

AWARDS

Best Paper Award Finalist | Design, Automation & Test in Europe Conference & Exhibition (DATE)   March 2022
NSF Travel Grant | Summer School on Formal Techniques (SSFT)   May 2018
SIGBED Student Travel Grant | Embedded Systems Week (ESWEEK)   September 2017
Merit Fellowship Award | The American University in Cairo (AUC)   Fall 2014
Merit Fellowship Award | The American University in Cairo (AUC)   Spring 2014

RESEARCH EXPERIENCE

Microfluidic Biochips | Duke University   January 2017 – June 2022

Developed a novel game-based probabilistic model for microfluidic droplet movement in micro-electrode-dot-array (MEDA) biochips.

Designed a framework for droplet routing in MEDA biochips using both formal synthesis and deep reinforcement learning.

Modeling and Synthesis of Assured Systems | Duke University   January 2016 – December 2021

Devised a formalism for modeling multi-agent systems with partial information, demonstrating its application in command-and-control supervisory systems.

Proposed a new temporal logic to aid with formalizing multi-objective requirements and an optimized algorithm for synthesis based on such requirements.

Human-Robot Interaction | Duke University

Led a team for extending Research Environment for Supervisory Control of Heterogeneous Unmanned Vehicles (RESCHU) experimental platform to simulate drone live video feed.

Assisted in the design an execution of human experiments, studying how operators can assist with detecting stealthy cyber-attacks that target navigational systems of unmanned aerial vehicles.

Microrobotics | The German University in Cairo (GUC)   January 2015 – October 2015

Designed a testbed for supervised nanoparticle manipulation to successfully achieve selective penetration of MCF-7 breast cancer cells without membrane or cell damage.

WORK EXPERIENCE

Valeo | R&D Efficiency Engineer   Cairo, Egypt | January 2014 – December 2015

Innovated and implemented new technical solutions and products to increase efficiency across all Valeo teams.

Achieved R&D efficiency target reduction of 10% in software testing activities.

Valeo | Embedded Software Engineer   Cairo, Egypt | June 2011 – December 2013

Designed and tested embedded software modules for automotive electronic control units of various OEMs, following a V-Cycle model.

Conducted a 6-month research and invented two hardware tools to facilitate testing and development activities, achieving over 20% savings in time spent in software validation.

Developed a generic testing framework for EEPROM/Dataflash emulation stack, reducing the time needed for memory stack development.

Collaborated with the development team in Valeo France to perform software/hardware integration.

Schneider Electric | Material Planning Engineer   Cairo, Egypt | October 2010 – February 2011

Performed raw material planning and procurement, supplier management, and stock level management.

Designed and deployed a tool to automate material consumption forecasting.

Schneider Electric | R&D Engineer   Cairo, Egypt | December 2008 – September 2010

Participated in the electromechanical design of new equipment and industrialization projects that respond to market and operation's needs.

Led a blue-collar team to successfully perform testing of mid-voltage power distribution equipment at an independent testing facility, rendering the equipment ready for the market.

Developed a design configuration tool that reduced the time to configure standard equipment by 50%.

Provided level-3 technical support to the operations functions as well as business and operational partners concerning the technical know-how of equipment.

PUBLICATIONS

1. Mahmoud Elfar, Yi-Chen Chang, Harrison Hao-Yu Ku, Tung-Che Liang, Krishnendu Chakrabarty, and Miroslav Pajic. Deep reinforcement learning-based approach for efficient and reliable droplet routing on MEDA biochips. <u>IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems</u>, 2022.

2. Mahmoud Elfar, Tung-Che Liang, Krishnendu Chakrabarty, and Miroslav Pajic. Adaptive droplet routing for MEDA biochips via deep reinforcement learning. In <u>2022 Design, Automation & Test in Europe Conference & Exhibition (DATE)</u>, pages 640–645. IEEE, 2022 **_(Best Paper Award Finalist)_**.

3. Mahmoud Elfar, Tung-Che Liang, Krishnendu Chakrabarty, and Miroslav Pajic. Formal synthesis of adaptive droplet routing for MEDA biochips. <u>IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems</u>, 2021.

4. Mahmoud Elfar, Tung-Che Liang, Krishnendu Chakrabarty, and Miroslav Pajic. Formal synthesis of adaptive droplet routing for MEDA biochips. In <u>2021 Design, Automation & Test in Europe Conference & Exhibition (DATE)</u>, pages 324–329. IEEE, 2021.

5. Mahmoud Elfar, Yu Wang, and Miroslav Pajic. Context-aware temporal logic for probabilistic systems. In <u>International Symposium on Automated Technology for Verification and Analysis</u>, pages 215–232. Springer, 2020.

6. Mahmoud Elfar, Yu Wang, and Miroslav Pajic. Security-aware synthesis using delayed-action games. In <u>International Conference on Computer Aided Verification</u>, pages 180–199. Springer, 2019.

7. Mahmoud Elfar, Haibei Zhu, Mary L Cummings, and Miroslav Pajic. Security-aware synthesis of human-UAV protocols. In <u>2019 International Conference on Robotics and Automation (ICRA)</u>, pages 8011–8017. IEEE, 2019.

8. Haibei Zhu, Mary L Cummings, Mahmoud Elfar, Ziyao Wang, and Miroslav Pajic. Operator strategy model development in UAV hacking detection. <u>IEEE Transactions on Human-Machine Systems</u>, 49(6):540–549, 2019.

9. Haibei Zhu, Mahmoud Elfar, Miroslav Pajic, Ziyao Wang, and Mary L Cummings. Human augmentation of UAV cyber-attack detection. In <u>International Conference on Augmented Cognition</u>, pages 154–167. Springer, 2018.

10. Mahmoud Elfar, Zhanwei Zhong, Zipeng Li, Krishnendu Chakrabarty, and Miroslav Pajic. Synthesis of error-recovery protocols for micro-electrode-dot-array digital microfluidic biochips. <u>ACM Transactions on Embedded Computing Systems (TECS)</u>, 16(5s):1–22, 2017.

11. Mahmoud Elfar, Haibei Zhu, Adithya Raghunathan, Yi Y Tay, Jeffrey Wubbenhorst, ML Cummings, and Miroslav Pajic. Platform for security-aware design of human-on-the-loop cyber-physical systems. In <u>Proceedings of the 8th International Conference on Cyber-Physical Systems</u>, pages 93–93. ACM, 2017.

12. Mahmoud Elfar, Mariam Ayoub, Aya Sameh, Hazem Abass, Reham M Abdel-Kader, Iman Gomaa, and Islam SM Khalil. Targeted penetration of mcf-7 cells using iron-oxide nanoparticles in vitro. In <u>2016 6th IEEE International Conference on Biomedical Robotics and Biomechatronics (BioRob)</u>, pages 260–265. IEEE, 2016.

TEACHING EXPERIENCE

Duke University | Teaching Assistant   Durham, NC | August 2017 – December 2018

ECE590-03 Cyber-Physical System Design (Spring 2018)

ECE590-11 Human-Robot Interaction (Spring 2017)

American University in Cairo | Teaching Assistant   Cairo, Egypt | August 2014 – December 2014
Microcontrollers and Mechatronics Systems (Fall 2014)
Robotics: Design, Analysis and Control (Fall 2014)

ACADEMIC SERVICES

IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD), 2022. *Reviewer*.

IEEE Open Journal of Control Systems (OJCSYS), 2022. *Reviewer*.

7th IFAC Conference on Analysis and Design of Hybrid Systems (ADHS), 2021. *Repeatability Evaluation Committee Member*.

IEEE International Conference on Robotics and Automation (ICRA), 2020. *Reviewer*.

IEEE VLSI Test Symposium (VTS), 2021. *Sub-reviewer*.

10th Conference on Decision and Game Theory for Security (GameSec), 2019. *Sub-reviewer*.

EXTRACURRICULAR

Meals on Wheels

TEDxDuke

SKILLS

Programming: C++, Embedded C, Python, Java

Tools: MATLAB, PRISM-games, Autodesk Inventor, OpenAI Gym, ROS, SAP

Languages: English (fluent), Arabic (fluent)