

## Defense of a Doctoral Dissertation

# Enhancing Safety and Reliability of Closed-loop Medical Control Systems by

**Shakil Mahmud**

For the Ph.D. degree in Computer Science and Engineering

The Internet of Medical Things (IoMT) is a rapidly advancing field that relies heavily on semi- or closed-loop Wearable and Implantable Medical Devices. In recent years, there has been renewed interest in clinical automation, with researchers looking for innovative solutions for Physiological Closed-Loop Control Systems (PCLCS). However, these devices can have various security issues, including vulnerabilities in software and firmware, physical attacks, weak encryption/authentication, and compromised system components. This dissertation focuses on various techniques to enhance the safety and reliability of PCLCS against natural defects and intentional malicious attacks. In addition, a hardware emulation platform is presented, suitable for simulating different faults and attacks on PCLCS components and evaluating the effectiveness of proposed countermeasures.

### Examining Committee

Ismail Uysal, Ph.D., Chairperson  
Robert Karam, Ph.D., Major Professor  
Srinivas Katkoori, Ph.D.  
Mehran Mozaffari Kermani, Ph.D.  
Nasir Ghani, Ph.D.  
Kaiqi Xiong, Ph.D.

Thursday, June 15<sup>th</sup>, 2023  
2:00 PM – 3:00 PM  
Hybrid (ENB 337 and [Online](#))

THE PUBLIC IS INVITED

### Publications

- 1) **S. Mahmud**, F. Zareen, B. Olney, and R. Karam. "Enhancing the Reliability of Closed-Loop Medical Systems with Real-Time Biosignal Modeling." *Journal of Hardware and Systems Security* (2023). [Under Review]
- 2) **S. Mahmud**, M. Keller, S. Ahmed, and R. Karam. "FAMID: False Alarms Mitigation in IoMT Devices." 6<sup>th</sup> IFIP International Internet of Things (IoT) Conference (2023). [Under Review]
- 3) **S. Mahmud**, S. Ahmed, and R. Karam. "Physiological Hardware Emulation Platform for Practical Security Assurance." 2023 IEEE Biomedical Circuits and Systems Conference (BioCAS). [Under Review]
- 4) **S. Mahmud**, S. Ahmed, and R. Karam. "PEP: Hardware Emulation Platform for Physiological Closed-loop Control Systems." 6<sup>th</sup> IFIP International Internet of Things (IoT) Conference (2023). [Under Review]
- 5) **S. Mahmud**, F. Zareen, B. Olney, M. A. Fernandes A., and R. Karam. "Trojan Resilience in Implantable and Wearable Medical Devices with Virtual Biosensing." 2022 IEEE 40<sup>th</sup> International Conference on Computer Design (ICCD) (pp. 577-584).
- 6) **S. Mahmud**, B. Olney, and R. Karam. "An Extensible Evaluation Platform for FPGA Bitstream Obfuscation Security." 2021 IEEE Computer Society Annual Symposium on VLSI (ISVLSI) (pp. 120-125).
- 7) **S. Mahmud**, S. J. A. Majerus, M. S. Damaser, and R. Karam. "Design Tradeoffs in Bioimplantable Devices: A Case Study with Bladder Pressure Monitoring." 2018 IEEE 24<sup>th</sup> Int. Symposium on On-Line Testing and Robust System Design (IOLTS) (pp. 69-72).
- 8) **S. Mahmud**, B. Olney, and R. Karam. "Architectural Diversity: Bio-Inspired Hardware Security for FPGAs." 2018 IEEE 3<sup>rd</sup> International Verification and Security Workshop (IVSW) (pp. 48-51).

*Robert Bishop, Ph.D.*  
*Dean, College of Engineering*

*Ruth H. Bahr, Ph.D.*  
*Dean, Office of Graduate Studies*

### **Disability Accommodations:**

If you require a reasonable accommodation to participate, please contact the Office of Diversity & Equal Opportunity at 813-974-4373 at least five (5) working days prior to the event.