UNIVERSITY OF SOUTH FLORIDA

Defense of a Doctoral Dissertation

Algorithmic Design and Optimization of Wireless Medical Technology for
Ambulatory Urodynamics
by

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

Lower urinary tract dysfunction (LUTD) is a debilitating medical condition that affects millions of individuals worldwide. Urodynamics is the current gold standard for diagnosing LUTD but uses non-physiologically fast, retrograde cystometric filling to obtain a brief snapshot of bladder function. Current state-of-the-art research in bladder monitoring includes ambulatory urodynamics using wireless implantable devices to evaluate bladder function during natural filling for long-term monitoring. However, there are various challenges and limitations to this approach, including significant physiological noise due to patient movement as well as limited data collection capabilities due to implant size and power constraints. This dissertation aims to address these challenges and limitations by developing a framework for automated chronic bladder data analysis and enhancing system recording capabilities with machine learning. In particular, this work proposes methods for estimating detrusor pressure from single-channel vesical pressure recordings using signal processing and neural network techniques, integration of accelerometry and bladder volume signals into the event detection framework using sensor fusion techniques, and optimization of sensing and event detection parameters using machine learning for system power reduction and reliability enhancement.

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THE PUBLIC IS INVITED

Publications

1) **F. Zareen,** et al. "Detrusor Pressure Estimation in Single-channel Urodynamics", 2022 44th Annual International Conference of the IEEE Engineering in Medicine and Biology Society.
2) **F. Zareen,** et al. "Towards Advancement of Ambulatory Urodynamics through NAR-based Biosignal Modeling", 2023 IEEE Biomedical Circuits and Systems Conference (BioCAS)**.** [Under Review]
3) **F. Zareen,** et al. "Improving Bladder Event Detection via Quantized Volume Estimation", 2023 Proceedings of the IMechE Part H: Journal of Engineering in Medicine. [Under Review]
4) **F. Zareen,** et al. "Optimizing Bladder Event Classification for Long-term Ambulatory Urodynamics", 2023 Proceedings of the IMechE Part H: Journal of Engineering in Medicine. [Under Review]
5) **F. Zareen,** et al. "Detecting RTL Trojans using Artificial Immune Systems and High-level Behavior Classification", 2018 Asian Hardware Oriented Security and Trust Symposium (AsianHOST).
6) **F. Zareen,** et al. "Hardware Immune System for Embedded IoT", 2022 IEEE Transactions on Circuits and Systems II: Express Briefs.

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