

The Waterloo Institute for Nanotechnology and the Department of Systems Design Engineering, University of Waterloo

Seminar Series

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Micro-Electro-Mechanical Neural Integrated Sensing and Computing Units for Wearable Device Applications

This presentation describes efforts to develop ultra low-power computing units for wearable devices that can locally execute machine-learning algorithms. The algorithms are coded in the mechanical response of coupled micro-electro-mechanical systems (MEMS) that simultaneously capture measurements, such as acceleration. Machine learning enabled wearables hold great potential to save lives via applications such as automatic fall detection early alarms. However, stringent space requirements limit their power supply to small batteries quickly drained by multiple read-out circuits and microprocessors. This contributes to non-adherence as users are frustrated by frequent devices recharging and false alarms triggered by low accuracy algorithms. To overcome these challenges, our novel approach moves computing to the physical sensing layer. This approach builds on the fact that the sensing element in MEMS sensors requires very little power, and that its mechanical response coupled with other sensing elements is complex and can be tuned to naturally perform machine learning algorithms on their own measurements. Thus, rather than producing raw measurement signals that need to be amplified, conditioned, and

converted from analog to digital to be read and processed by a microprocessor, the response of the multiple sensing elements will collectively encode high-level information.



Dr. Fadi Alsaleem is Assistant Professor of Architecture and Mechanical Engineering at the University of Nebraska–Lincoln. Dr. Alsaleem received the B.S. degree in mechatronics engineering from The Hashemite University, Jordan, in 2003, and the M.S. and Ph.D. degrees in mechanical engineering from The State University of New York at Binghamton, NY, USA, in 2007 and 2009, respectively.

He was Assistant Professor of Mechanical Engineering at Wichita State University, from 2015 to 2016. Prior to this, he was a Senior Lead Algorithm Engineer at Emerson Climate Technology for four years, and a MEMS Control Engineer at DunAn Microstaq for a couple of years. Since 2016, he has been with the Architecture Engineering and the Mechanical Engineering (courtesy appointment) Departments, University of Nebraska–Lincoln. He is an active researcher in the areas of Neuromorphic Computing, MEMS, and Smart Buildings. He has published over 70 peer-reviewed conferences and journal papers. He has filed over 15 pending and granted patents in the area of MEMS adaptive control and cloud-based online monitoring and diagnostics.

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