In this research summary from *IISE Transactions on Healthcare Systems Engineering* (Volume 9, No. 1), researchers Changqing Cheng and Hui Yang showed how wearable devices with sensors to track the movement of patients in an assisted-living facility can help diagnose cases of dementia. The second article on research by a faculty team led by Suchithra Rajendran examines the effect of pharmaceutical side-effect listings on sales vs. legal action.

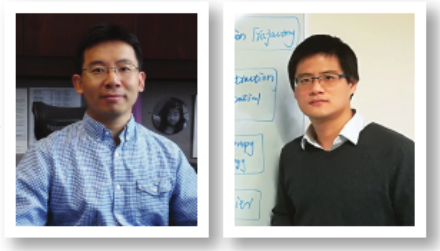
Daily activity monitoring can help diagnose dementia

Dementia is a general term of brain dysfunction that embodies deterioration in cognitive function beyond the normal phenomenon of aging. This progressive neurodegenerative disorder is overwhelming not only for the patients, but also negatively affects their caregivers, families and society. The improvement of dementia care delivery hinges on the early detection and real-time monitoring of temporal degradation before the devastating symptoms unfold.

In the state of the art, paper-based survey methods such as Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) are widely used for the assessment of dementia conditions. However, these methods require lab visits or administrations from nurses, physicians and examiners, and are limited in the ability to track temporal degradation, or daily variations, of dementia conditions.

Wearable sensing provides significant opportunities to develop new sensor-based approaches with a higher level of flexibility for dementia monitoring and with minimal intervention requirements from caregivers.

In "Multi-Scale Graph Modeling and Analysis of Locomotion Dynamics Toward Sensor-based Dementia Assessment," Changqing Cheng of Binghamton University and Hui Yang of Pennsylvania State University deployed a wireless gait-sensing system to track the locomotion dynamics of subjects residing in an assisted living facility while they were performing daily routine tasks. Real-time monitoring is critical to the screening and detection of dementia in a timely fashion.



Hui Yang (left) and Changqing Cheng developed a wireless gait-sensing system to track the locomotion dynamics of assisted-living facility residents to aid in the screening and detection of dementia.

This wireless sensing system does not require significant investment as in smart home systems or higher-level expert interventions but can perform real-time monitoring of daily locomotion dynamics with cheaper accelerometer sensors. Further, researchers developed analytical methods to characterize the movement patterns from data collected with the wireless sensing system and further extract biomarkers to differentiate between normal and dementia-altered locomotion trajectories rather than extraneous factors and noises.

Such sensor-based methods can assist in the optimization of health management and treatment for dementia-afflicted subjects, a population that is anticipated to increase as baby boomers age and life expectancy edges up. This research is partly supported by a National Science Foundation sponsored project "Sensing, Modeling and Optimization of Postoperative Heart Health Management," for which Yang is the principal investigator.

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Should pharmaceutical companies label side effects? Lawsuits vs. lost sales

Though pharmaceutical drugs help in the prevention or cure of diseases in humans, the usage of these medicines might cause several side effects. The severity of drug-related reactions can be minimal, such as loss of appetite, or extremely serious, such as liver damage. Billions of dollars in lawsuits have been filed against pharmaceutical companies across the globe by consumers who have experienced reactions that were not brought to their attention (i.e., not listed on the drug label).

Fearing they can potentially face expensive class-action lawsuits, drug manufacturers cautiously decide to list all the possible reactions of a product. The idea is to help minimize lawsuits by adequately informing patients of the potential drug aftereffects via the product label. However, listing many reactions might make the customers reluctant to use the drug, which may increase their health risk. Nearly half of the patient population in the U.S. refrain from taking their medications due to the fear of reactions listed on the drug products. Both physicians and pharmaceutical companies continue to try to find ways to reduce their distress of taking drugs and increase patient adherence.

The aforementioned information indicates the need to find a trade-off between the loss of potential customers by declaring side effects and the cost of class-action lawsuits due to not revealing the drug reactions. This problem can be treated as a multiple criteria decision-making problem where the two conflicting criteria can be evaluated to achieve the best compromise solution for patients and pharmaceutical companies.

Thus, an interdisciplinary team of faculty members at the University of Missouri (Suchithra Rajendran) and Penn State University (Jeya Chandra), data scientist from Engineering Technology Associates Inc. (Afrooz Ansaripour) and Chief Executive Officer of AlphaMD