

Biological Design Doctoral Defense

Advancing Methods to Monitor and Assess Personal Ultraviolet Radiation Exposure During Physical Activity

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Abstract

Ultraviolet (UV) radiation is the most well-known cause of skin cancer, and skin cancer is the most common type of cancer in the United States. People are exposed to UV rays when they engage in outdoor activities, particularly exercise, which is an important health behavior. Thus, researchers and the general public have shown increasing interest in measuring UV exposures during outdoor physical activity using wearable sensors. However, minimal research exists at the intersection of UV sensors, personal exposure, adaptive behavior due to exposures, and risk of skin damage. Three studies are presented in this dissertation: (1) a state-of-the-art review that synthesizes the current academic and grey literature surrounding personal UV sensing technologies; (2) the first study to investigate the effects of specific physical activity types, skin type, and solar angle on personal exposure in different outdoor environmental contexts; and (3) a study that develops recommendations for future UV-sensing wearables based on follow-up interviews with participants from the second study, who used a wrist-worn UV sensor while exercising outdoors. The first study provides recommendations for 13 commercially available sensors that are most suitable for various types of research or personal use. The review findings will help guide researchers in future studies assessing UV exposure with wearables during physical activity. The second study outlines the development of predictive models for individual-level UV exposure that recommend the inclusion of sky view factor, solar angle, activity type, urban environment type, and the directions traveled during physical activity. Finally, based on user feedback, the third study recommends that future UV-sensing wearables should be multi-functional watches where users can toggle between showing their UV exposure results in cumulative and countdown formats. UV exposure results should be shown as both cumulative and countdown-formatted ring graphs to look intuitive and aesthetically pleasing to users.



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Zoom Link: <https://asu.zoom.us/j/4729443833>