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Preston M. Green Department of Electrical and Systems Engineering

Improving Radio Frequency Sensing for Smart Health Applications

PhD Dissertation Defense

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Abstract: In recent years, the use of radio frequency (RF) signals for the purpose of human-centered sensing has demonstrated the capability to address shortcomings in other sensing modalities and created opportunities for new applications. In smart health monitoring, information about human vital signs, environment, and person's movements is used to determine the physical activity of a subject and trigger preemptive action prior to a potential health risk. RF sensing enables smart systems in which health monitoring is performed with non-contact sensors, and potential health risks like injuries caused by collisions between sports players are reduced with ranging and collision prediction. In order to repurpose commercial radio transceivers as inexpensive RF sensors for smart health, an RF sensing system needs to address its particular challenges, such as its high spectrum utilization needs and quantization issues that arise because standard transceivers were not designed with RF sensing in mind. On the other side, attackers can use standard radio transceivers to perform RF sensing that invades privacy, for example by monitoring people's activities in their homes. Proper design of wireless transceivers could reduce the feasibility of such attacks. This thesis presents new estimators, RF sensing systems, analysis tools and evaluates their performance and spectrum efficiency. These contributions are developed both for the development of smart health sensors as well as to inform the design of devices, which, for privacy reasons, do not reveal health information.

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