Docket #: S20-328

Wearable activity monitor to track metabolic energy expenditure

Stanford engineers have developed a wearable, real-time activity monitor that estimates metabolic energy expenditure with substantially lower error than current methods such as smartwatches. This new wearable system uses two sensors (inertial measurement units (IMUs)) worn on the thigh and shank as they distinguish lower-limb activity better than wrist or trunk kinematics and converge more quickly than physiological signals.
Results of tests showed cumulative error of 13% across common activities, significantly less than 42% for a smartwatch and 44% for an activity-specific smartwatch. This approach enables more accurate physical activity monitoring for new energy balance systems for weight management or large-scale activity monitoring.

Stanford News Article 7/13/21 - "Stanford engineers design an accurate wearable calorie burn counter"

Video

Video Credit-inventors

Stage of Development:
Prototype tested with a diverse group of new subjects and new conditions for walking, running, stair climbing, and biking

Applications

- **Smart devices** for accurately estimating energy expenditure, or calories burned, during exercise for weight management or athletic performance
- **Physiological monitoring** for cardiovascular disease or other conditions

Advantages

- **Novel** - first device to accurately estimate energy expenditure during time-varying activities, for example short bursts of walking and sports such as soccer or basketball where people frequently change speeds between walking and running
- **Accurate** – 3x more accurate than existing wearable devices such as smartwatches
- **Real time** - measures instantaneous changes in energy expenditure (no delay)
- **More practical** than the gold standard, respirometry, which is expensive and not portable

Publications

- Slade, Patrick, Mykel J. Kochenderfer, Scott L. Delp, and Steven H. Collins. "Sensing leg movement enhances wearable monitoring of energy expenditure." *Nature communications* 12, no. 1 (2021): 1-11.

Innovators

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