

Instrumented Sock: Dynamic Thermal Mapping & Footwear Microclimate Assessment Tool

Company: Deckers Outdoor Corporation (Parent company of HOKA, UGG, Teva)

Location: Goleta, California

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Background

Footwear microclimate, specifically the management of temperature and moisture, is a critical factor influencing user comfort, athletic performance, and foot health. Thermal regulation varies significantly across different footwear categories, from highly insulated winter boots (e.g., UGG) to high-performance running shoes (e.g., HOKA) and open-air footwear (e.g., Teva). Excessive heat accumulation can lead to discomfort, increased sweating, skin maceration, blister formation, and reduced endurance, while insufficient thermal retention in cold environments impairs muscle function and comfort.

Currently, thermal evaluation of footwear during research and development often relies on qualitative user feedback, static thermal imaging (FLIR) taken only after shoes are removed, or bulky single-point thermocouples. These approaches fail to capture continuous, real-time thermodynamic changes across the full foot and lower leg anatomy.

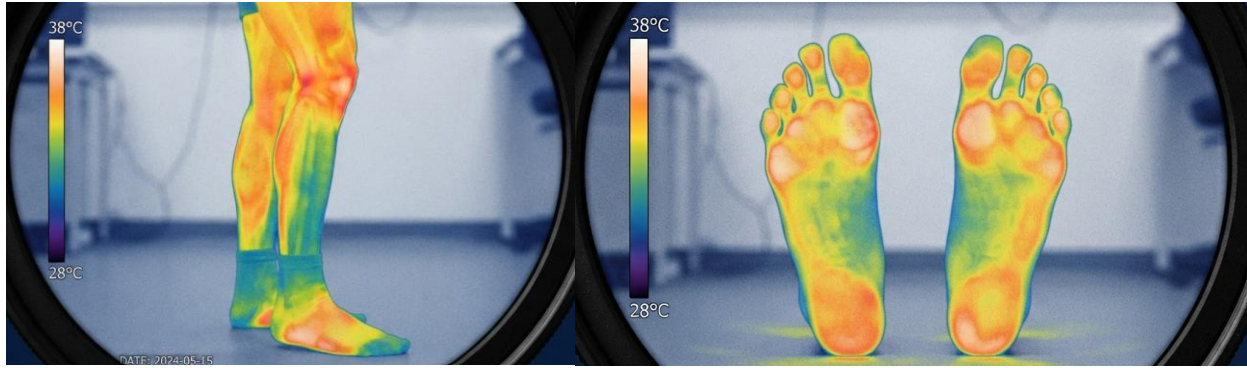
A dynamic, continuous thermal mapping tool is needed to measure real-time temperature fluctuations before, during, and after activity. Furthermore, interpreting foot and lower-leg temperature requires an understanding of the external environment; dynamic changes can only be properly benchmarked when correlated against ambient atmospheric conditions.

Objective

The objective of this project is to develop a **below-the-knee instrumented sock** embedded with a high-density array of thermal sensors to objectively and continuously measure temperature distribution throughout the foot and lower leg.

The system will enable engineering and innovation teams to capture a comprehensive thermal profile of the body across three critical phases:

1. **Pre-Wear (Baseline):** Establishing resting foot/leg temperature profiles prior to donning footwear.
2. **During Wear (Dynamic Activity):** Measuring real-time heat buildup, distribution, and thermal zones under active movement.
3. **Post-Wear (Cool-Down / Recovery):** Tracking heat dissipation, moisture evaporation effects, and thermal decay after footwear removal.



Key Requirements & System Specifications

- **Form Factor & Sensor Density:**
 - Below-the-knee sock architecture incorporating as many low-profile, non-intrusive thermal sensors as feasible.
 - Distributed multi-zone coverage across key anatomical areas (plantar surface, heel, instep, dorsal foot, medial/lateral arch, ankle, Achilles tendon, and lower calf/shin).
 - Sensors must not interfere with natural gait or significantly alter the fit inside standard footwear.
- **Sampling & Readout Frequency:**
 - System must record and read out data points continuously at intervals between **10 to 30 seconds** across all channels.
- **Ambient Environmental Sensing:**
 - Integrated external temperature sensor (positioned outside the footwear/cuff) to continuously record baseline ambient temperature alongside physiological readings.
- **Data Acquisition & Logging:**
 - Low-power onboard micro-controller with wireless transmission (e.g., BLE) or onboard storage (microSD) capable of logging full sessions across all phases.
 - User interface / dashboard to visualize real-time heatmaps and time-series thermal gradients correlated with ambient data.
- **Durability & Usability:**
 - Repeatable, resilient to sweat/mechanical flexure, and suitable for both benchtop/laboratory testing and dynamic gait/running trials.
 - Machine or hand washable without harming the electronics.

About Deckers Brands

Deckers Brands is a global leader in designing, marketing and distributing innovative footwear, apparel and accessories developed for both everyday casual lifestyle use and high performance activities. The Company's portfolio of brands includes UGG®, HOKA®, Teva®. Deckers Brands products are sold in more than 50 countries and territories through select department and specialty stores, Company-owned and operated retail stores, and select online stores, including Company-owned websites. Deckers Brands has over 50-years of history building niche footwear brands into lifestyle market leaders attracting millions of loyal consumers globally.