Docket #: S23-154

Gait Analysis and Monitoring using Floor-Mounted Geophone Sensors

Stanford researchers in the Noh Lab have developed a non-intrusive, scalable approach to gait analysis. Gait analysis, which is typically performed in a clinical setting, is a key component in the diagnosis, progressive tracking, and rehabilitation of musculoskeletal injury or neuromuscular disorders, such as dementia, cerebral palsy, muscular dystrophy, and stroke, as well as fall prediction in the elderly. The Noh Lab invention (see figure 1) uses floor-mounted vibration sensors (geophones) to capture floor vibrations generated by footsteps during walking. The data is processed using machine learning algorithms to estimate various gait parameters, including temporal parameters (step, stride, stance, swing time), and spatial parameters (step length, width, angle), as well as health indicators (cadence, left-right symmetry, gait balance, initial contact type), which are important for gait abnormality detection and characterization.

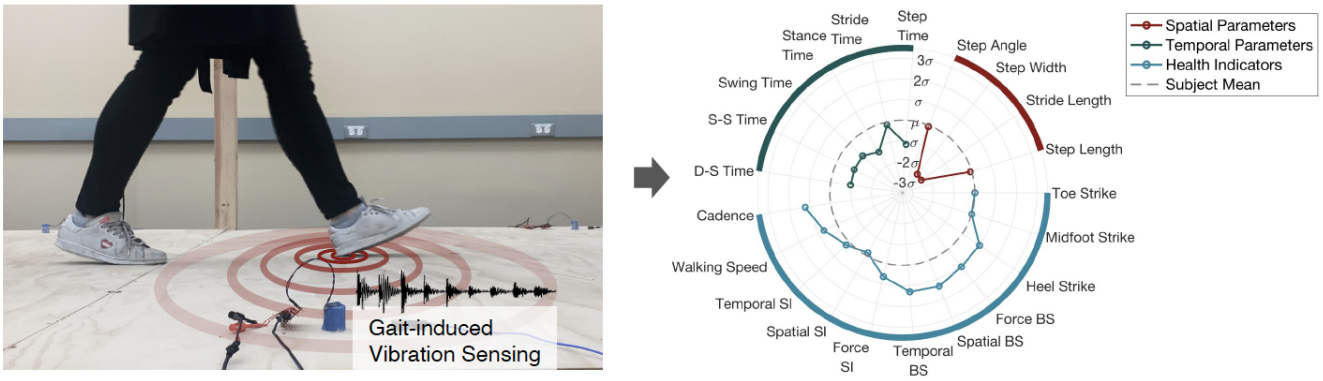

Figure 1 Gait Analysis via Geophone Sensors
Image courtesy the Noh Lab

This non-intrusive, scalable, and perceived as privacy-friendly gait analysis provides continuous monitoring of an individual's gait parameters and health-related information at home, allowing for early detection of health issues, evaluation of

rehabilitation program effectiveness, and timely interventions when needed.

Stage of Development – Proof of Concept
The Noh Lab tested a proof-of-concept prototype. Work is ongoing to migrate algorithms to mobile devices for an easy-to-use product that includes the sensor, data transmission module, and user interface.

Applications

- Non-clinical and clinical gait monitoring for:
  - Quantitative functional/mobility/balance scoring
  - Abnormal gait detection
  - Surgical and therapeutic intervention planning
  - Neuromuscular/musculoskeletal disease research
  - Orthosis design
- Non-clinical, smart home, monitoring for:
  - Fall risk assessment and detection
  - Rehabilitation tracking
  - Early discovery of neuromuscular/neurological diseases
  - Sports performance improvement
  - Activity tracking

Advantages

- Suitable for continuous monitoring in daily life
- Non-intrusive
- Easily scalable
- Perceived as privacy-friendly

Publications

- Dong, Y., & Noh, H. Y. (2024). Ubiquitous Gait Analysis through Footstep-Induced Floor Vibrations. doi: 10.20944/preprints202403.0617.v1.

Patents

- Published Application: 20240423503

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