Docket #: S23-288

Convex Formulation of Continuous Time Heartbeat Dynamics

Researchers at Stanford have developed a fast and accurate algorithm for analyzing heartbeat patterns in real time.

Heart rate variability (HRV) is a critical biomarker for mental health, inflammation, and cardiovascular monitoring but current tools are either too simple to capture meaningful patterns or too complex for practical use. This innovation offers a powerful alternative: a precise, continuous-time analysis model that avoids the computational challenges of existing methods.

The result is a scalable solution for real-time HRV tracking that runs up to 4x faster than current approaches. It's designed for ease of use by non-experts, making advanced heartbeat analytics accessible across wearable devices, consumer health apps, and clinical monitoring systems.

This innovation supports new products and platforms that rely on continuous, interpretable cardiovascular signals for the next generation of digital health tools, smarter wellness trackers, and more responsive patient monitoring systems.

Applications

- Real-time HRV monitoring in wearable health devices (e.g., Apple Watch, Fitbit)
- Continuous autonomic function tracking in clinical monitoring systems
- Integration into wellness apps for stress and recovery assessment

Advantages

- Runs up to 4x faster than existing point-process models
- Enables continuous-time HRV metrics with higher temporal resolution

- Improves accuracy over windowed or heuristic HRV methods
- Compatible with both consumer and clinical heart rate sensors

Publications

- Perley, A., Subramanian, S., & Coleman, T. P. A Convex Formulation of Point Process Heartbeat Dynamics using a Gamma Generalized Linear Model. 2023 IEEE 19th International Conference on Body Sensor Networks (BSN), Boston, MA, USA, 2023, pp. 1-5

Patents

- Published Application: 20250114045

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