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P64 Carotid Artery Tracking with Automated Wall Position Resets Yields Robust Distension Waveforms in Long-term Ultrasonic Recordings

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ABSTRACT

Background: Carotid artery tracking has high clinical relevance for the investigation of arterial stiffness indicators like Pulse Wave Velocity (PWV). However, current tracking systems are unreliable and/or not fully automated [1,2]. In this work we propose a novel wall tracking algorithm for long-term ultrasonic recordings, featuring automated beat-to-beat end-diastolic wall position resets.

Methods: Carotid artery ultrasound (Vantage64, Verasonics, USA) and simultaneous ECG (ECG100C, BIOPAC, USA) were acquired from 10 subjects (38 ± 10 years) in 6 repeated measurements, each involving a resting, breathing and handgrip intervention. The ECG triggers an automated algorithm, whose heuristics utilize the hypoechogenic lumen to detect the end-diastolic wall positions in the ultrasound data. Subsequently, wall motion is tracked throughout the cardiac cycle by complex cross-correlation [3]. Further processing yields carotid distension waveforms and local PWV via spatiotemporal fitting of waveform fiducials. The novel per-beat algorithm was benchmarked against a manually initialized per-intervention algorithm, while ground truth wall positions were manually annotated. Performance was assessed for temporal efficiency, spatial accuracy and feature consistency.

Results: Average results show a ~4000% higher temporal efficiency, 20% increased spatial accuracy (μ error: 0.66 to 0.53 [mm]) and 14% improved feature consistency (σPWV: 2.2 to 1.9 [m/s]) for the per-beat algorithm. Results of exceptional cases reveal even more significant performance, e.g. 60% increased spatial accuracy (μ error: 1.57 to 0.64 [mm]) for gradual drift and 58% improved feature consistency (σPWV: 1.9 to 0.8 [m/s]) for instant vessel loss (see Figure 1).

Conclusion: The proposed algorithm demonstrates significant temporal efficiency, spatial accuracy and feature consistency, particularly during perturbations. Such robustness is essential for long-term monitoring, making the algorithm a powerful tool in ambulatory vascular research.

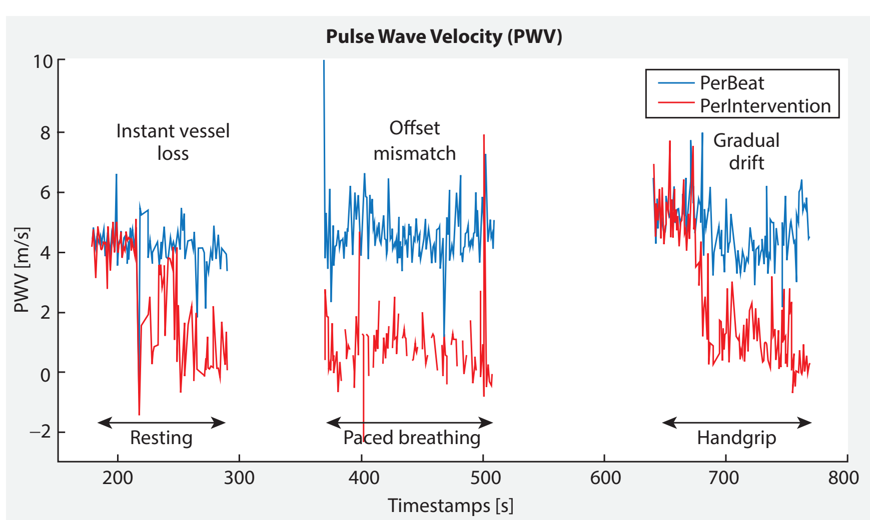

Figure 1

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