An Observer-Egocentric Approach to Real-World Gait Analysis

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CVPR JUNE 3-7, 2026 DENVER COLORADO

Introduction

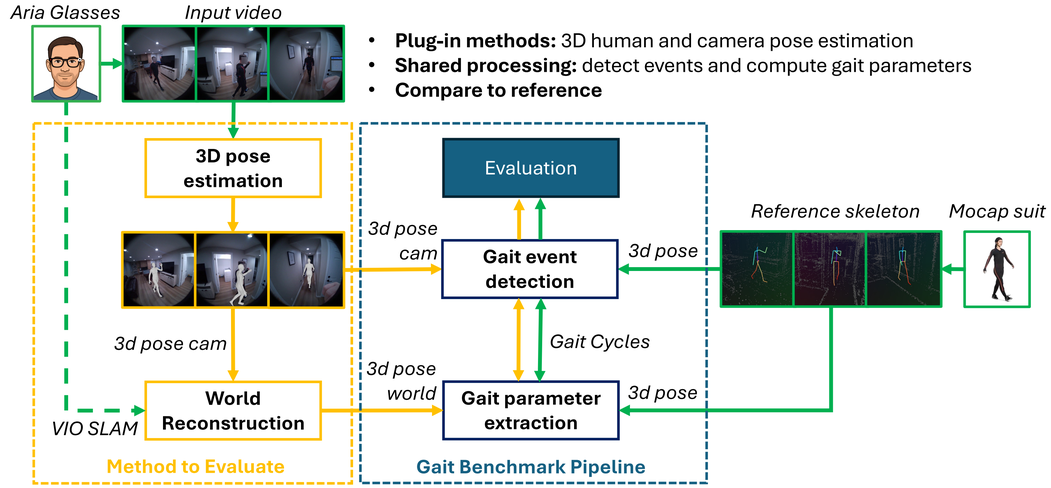
Goal: Enable quantitative gait analysis during routine real-world observation.

Challenges:
- Existing gait datasets are mostly controlled environment, static-camera, or lack biomechanical reference
- Standard 3D pose evaluation metrics such as MPJPE may not reflect application-specific performance.

Contributions

- **Nymeria-Gait:** Real-world observer-egocentric gait dataset with biomechanical reference subset of Nymeria[1]
- **Modular Benchmark pipeline:** Egocentric video → 3D motion → Gait parameters → Comparison to reference
- **Evaluation of current methods**

Modular Benchmark Pipeline



- **Plug-in methods:** 3D human and camera pose estimation
- **Shared processing:** detect events and compute gait parameters
- **Compare to reference**

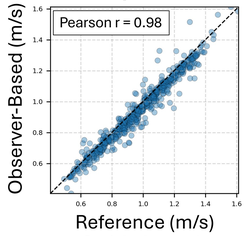
Evaluation

Best performing evaluated configuration: WHAM[2] + Aria glasses VIO SLAM

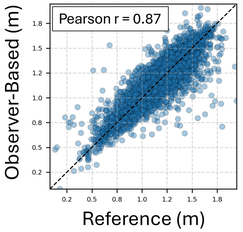
Results: 96.6% gait-event detection

Parameter	mean ± SD
Cycle time (ms)	0.2 ± 39.8
Stance time (ms)	−5.3 ± 45.1
Swing time (ms)	5.5 ± 43.5
Speed (m/s)	−0.03 ± 0.04
Distance (m)	−0.18 ± 0.34
Stride length (m)	−0.004 ± 0.116

Speed

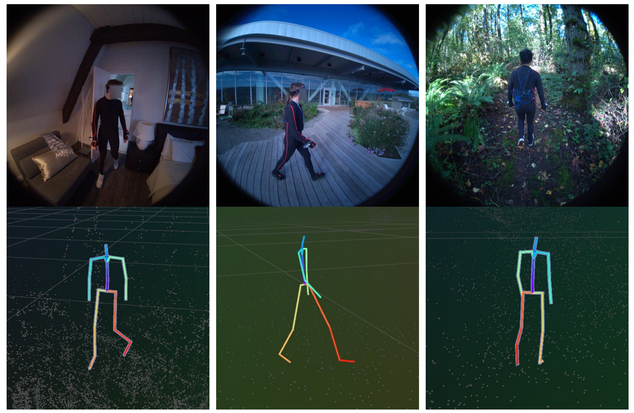


Stride Length



- **Strong temporal performance:** gait timing errors ≤ 5.7 ms, with precision ≤ 45.1 ms
- **Open Challenge:** Stride length precision remains insufficient for clinical use

Nymeria-Gait Dataset



54 participants	**908** sequences	**7.9 km** distance	**142 min** recording
26,685 events	**11,437** cycles	**2.4 / 5.5 km** indoor / outdoor	**Flat / Up / Down** slope

Dataset	Camera setting	Gait-specific	Biomechanical reference	Indoor + outdoor	Gait pipeline
TUM-GAID / CASIA / GAVD / PKU-HumanID	Static-cameras	✓		partial	
Human3.6M / MoVi / GPJATK	Static-cameras	partial	✓		
3DPW / EMDB	Mobile monocular		✓	✓	
EgoBody	Egocentric		✓	indoor	
Nymeria-Gait	**Egocentric**	✓	✓	✓	✓

Conclusion

- Encouraging results for real-world observer-egocentric gait analysis
- Nymeria-Gait exposes strengths and weaknesses of 3D pose methods through application-specific benchmarking

Dataset **Project**

Reference:
[1] L. Ma et al., Nymeria: A Massive Collection of Multimodal Egocentric Daily Motion in the Wild, ECCV, 2024.
[2] S. Shin et al., WHAM: Reconstructing World-Grounded Humans with Accurate 3D Motion, CVPR, 2024.