

Optimized Pose-Based Gait Analysis for Surveillance

Research presentation deck

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“Optimized Pose-Based Gait Analysis for Surveillance”

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Focus: marker-free gait analysis for surveillance scenarios

Why gait analysis matters in surveillance

Gait can identify or characterize people even when face-level detail is unavailable

Research problem

Surveillance videos often lack clear face or fingerprint-style biometric information.

Walking patterns provide spatial and temporal cues useful for recognizing moving people.

The challenge is to extract joint positions without markers, sensors, or controlled clothing.

Key challenge: robust joint extraction under clothing, view changes, segmentation errors, and indoor/outdoor capture conditions.

Based on the paper introduction and abstract.

Optimized Pose-Based Gait Analysis for Surveillance

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Abstract. In the most recent decade, researchers have lavished attention to human activity analysis, owing to its potential use in various fields. We suggest an alternative method for dealing with individual human joints (vertex positions) based on a model-based approach. The elliptic Fourier descriptors parameterize the movement formats that reflect the joint movement as inferred from walk inquiry. The heel strike data is manipulated to reduce the dimension of the parametric models. Spatial and temporal features characterize an Individual's walk, and we are capturing both. For indoor and outdoor information, the lower leg, knee, and hip joints are effectively and precisely extracted. Various experiments are done to make a marker-free inquiry, and various zones were created. The exploratory results confirmed the proposed technique's efficacy in perceiving walking objects with a 92% accuracy in characterization rate. Our suggested methodology applies to various surveillance scenarios, including pedestrian, subway, bus stop, airport, and bank surveillance.

Keywords: Model-Based, Gait, Pose based, Biometrics, Surveillance

1 Introduction

Most computer vision research is integrated into the study of explained structu

Proposed methodology

Pose-based gait pipeline using spatial pose features and heel-strike temporal cues

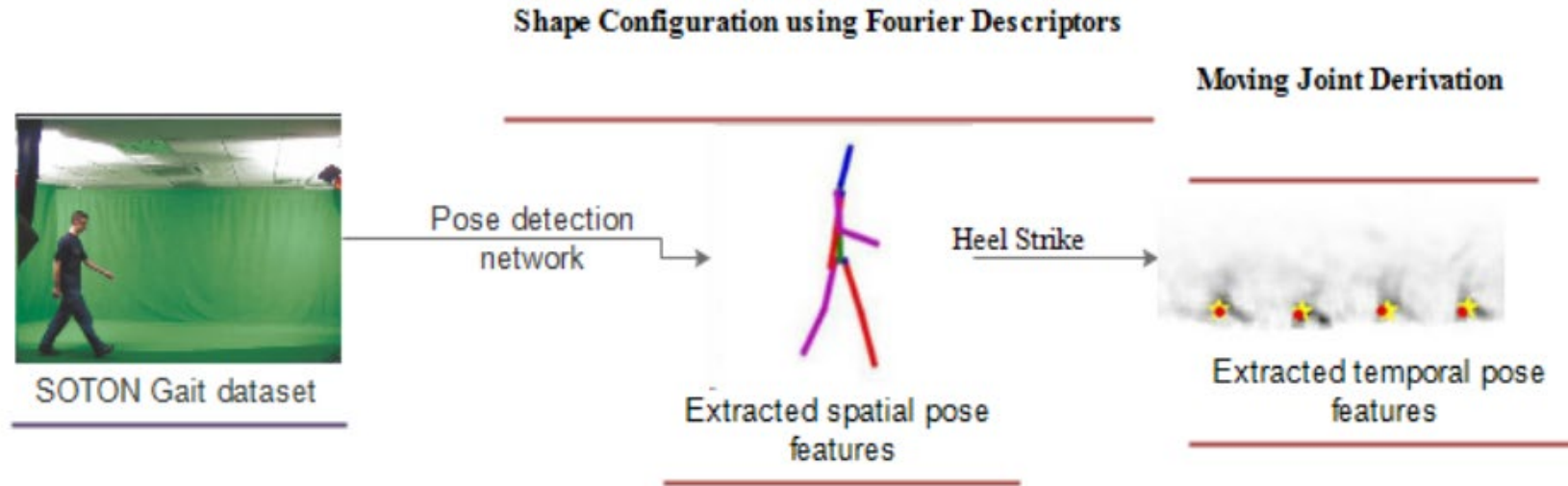


Fig. 1. Proposed methodology to collect spatial and temporal features.

Pipeline interpretation

SOTON gait video is converted into extracted spatial pose features; heel-strike events then provide temporal cues for joint movement derivation.

Visual source: Fig. 1 from the uploaded ICICV-2021 paper.

Technical core: from shape to joints

The method combines Fourier shape modeling with heel-strike extraction

1 Shape configuration

Elliptic Fourier descriptors parameterize moving body shapes and reduce complex shape boundaries into compact descriptors.

2 Heel-strike extraction

Heel strikes indicate gait periodicity and help constrain the search space for lower-limb joint positions.

3 Moving joint derivation

Evidence gathering and Hough-style voting derive joint locations across frames, then local extraction refines them.

Fig. 2. Heel Strike Extraction.

During the strike process, the striking leg's foot stays in a single location for most walk period, whilst the rest of the human body moves forward. If we use a low-element extraction technique (edges or corners), a dense region would be aggregated at the heel strike areas. Since the main goal of this investigation is to see human movement, it was agreed to use corners rather than edges because corners hold enough information to see human movement. In contrast, edges can create ambiguity in the extraction process due to the amount of data.

Moving Joint Derivation

A model-based technique is used to restrict the joints for walking sequences to

Heel-strike extraction visual

Dense corner evidence around the heel helps identify the periodic contact point in walking.

Visual source: Fig. 2 from the uploaded paper.

Experimental setup

Evaluation uses SOTON gait sequences with indoor and outdoor examples

Data and evaluation

120 unique subjects from the SOTON database.

100 subjects captured indoors under controlled conditions.

Additional outdoor subjects captured in natural light.

Lower-leg, knee, and hip joint paths analyzed over the gait cycle.

What is measured?

Joint localization quality, heel-strike extraction, and recognition/classification performance from gait-derived features.

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Paper title page

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Reported results

The method demonstrates strong heel-strike extraction and promising recognition performance

99.2%

heel-strike extraction reported over 514 strikes

0.52%

average heel-strike position error normalized by subject height

1.36%

mean extracted joint-location error versus manual labels

92%

classification rate stated in the abstract/conclusion for person recognition

TABLE 1. Comparison of various accuracy.

Paper	Dataset	Accuracy
[13]	SOTON	55
[14]	CASIA B	63
[15]	SOTON	92
[16]	CASIA A	70
Ours	SOTON	99.2

Visual source: results table from page 5 of the paper.

Motion analysis of joints

Extracted joint trajectories show ankle, knee, and hip patterns across the gait cycle

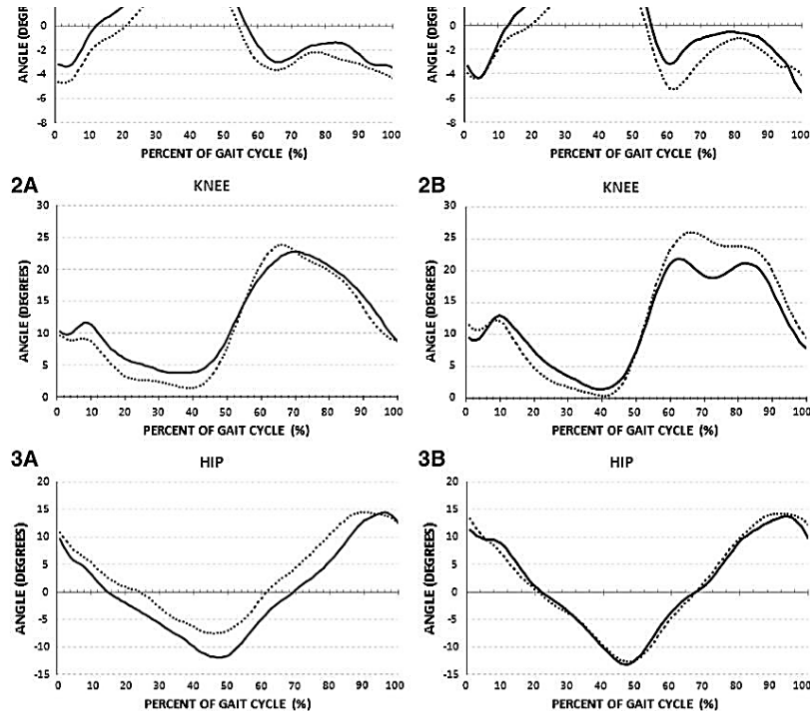


Fig. 3. Motion Analysis of joints (1) Ankle (2) Knee (3) Hip.
(A) Normal walking speed (B) Fast Walking speed

The proposed strategy effectively extracted 99.2 percent of the strikes from a total of 514 strikes for the position of the heel strike focuses as shown in figure 3. The average error for 65 strikes calculated by the equation vs strikes visually labelled is 52 percent of the person height. Since this is the most common explanation for standardization, the error is measured using Euclidean separation between the two strikes standardized to a measure of the individual's stature. The mean error for the

What the plots show

Ankle, knee, and hip angle trajectories are measured over a normalized gait cycle. Normal walking speed and fast walking speed are compared side-by-side. The extracted trajectories remain close to expected biomechanical movement patterns.

Takeaway

The model-based pipeline is not only a classifier: it gives interpretable joint-level motion evidence that can be inspected in surveillance analysis.

Main contribution and impact

A marker-free, model-based approach to gait analysis for practical surveillance settings

Core contribution

The paper proposes a method that extracts moving human joints using model-based evidence gathering, Fourier descriptors, and heel-strike cues.

Why it matters

Works without physical markers or wearable sensors.

Targets both indoor and outdoor surveillance environments.

Provides interpretable joint trajectories, not only a final identity score.

Application areas mentioned in the paper include pedestrian, subway, bus stop, airport, and bank surveillance.

Thank You

Questions & Discussion

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