Motion Cues Analysis for Parkinson Gait Recognition

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Background

Previous assessment methods for Parkinsonian Gait (PG) recognition used sensor mechanisms for PG that may cause discomfort. In order to avoid stress of applying wearable sensors, computer vision (CV) based diagnostic systems for PG recognition have been proposed. Main constraints in these methods are the laboratory setup procedures. Novel colored dresses for the patients were specifically designed to segment the test body from a specific colored background [1-3].

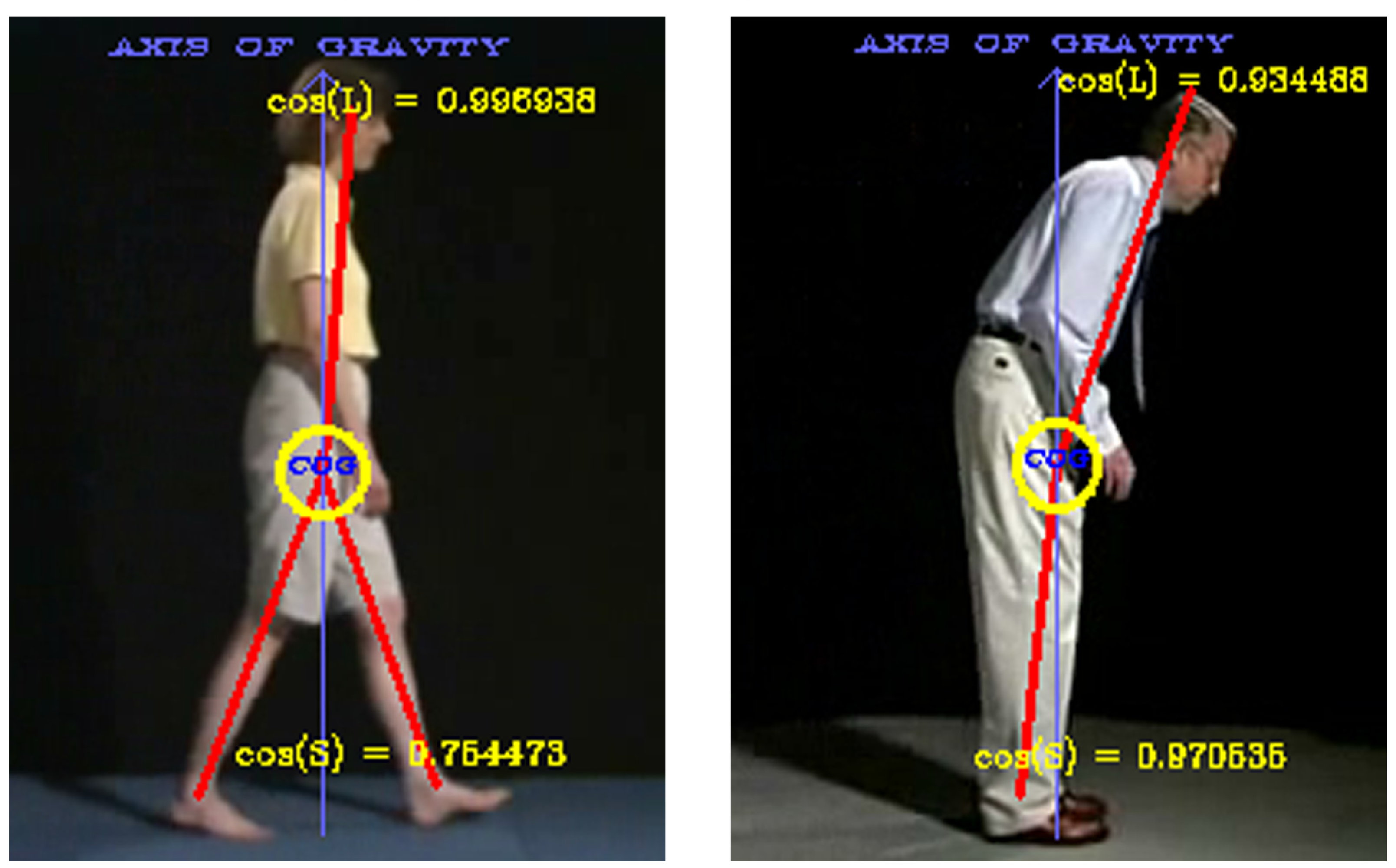
Objective

To develop an image processing tool for home-assessment of Parkinsonian Gait by analyzing motion cues (i.e. stride and lean frequencies) extracted during the gait cycles.

Methods

The system is based on the idea that a normal body attains equilibrium during the gait by aligning the body posture with the axis of gravity. Due to the rigidity in muscular tone, persons with Parkinson's disease (PD) fail to align their bodies with the axis of gravity. The leaned posture of PD patients appears to fall forward [4]. Whereas a normal posture exhibits a constant erect posture throughout the gait. Patients with PD walk with shortened stride angle (less than 15 degrees on average) between the legs with high variability in the stride frequency. Whereas a normal gait exhibits a constant stride frequency with an average stride angle of 45 degrees between the legs [5]. In order to analyze PG, levodopa-responsive patients and normal controls were videotaped with several gait cycles. First, the test body is segmented in each frame of the gait video based on the pixel contrast from the background to form a silhouette. Next, the centre of gravity of this silhouette is calculated. This silhouette is further skeletonized from the video frames to extract the motion cues. Two motion cues were stride frequency based on the cyclic leg motion and the lean frequency based on the angle between the leaned torso tangent and the axis of gravity (Fig 1). The differences in the peaks in stride and lean frequencies between PG and normal gait are calculated using Cosine Similarity measurements.

Figure 1.
Motion cues extracted from the image skeletons of a normal person and a Parkinson's patient respectively are shown. COG represents center of gravity of the human silhouette. COS (L) is the lean angle between the torso and the axis of gravity. COS (S) is the stride angle between the legs.

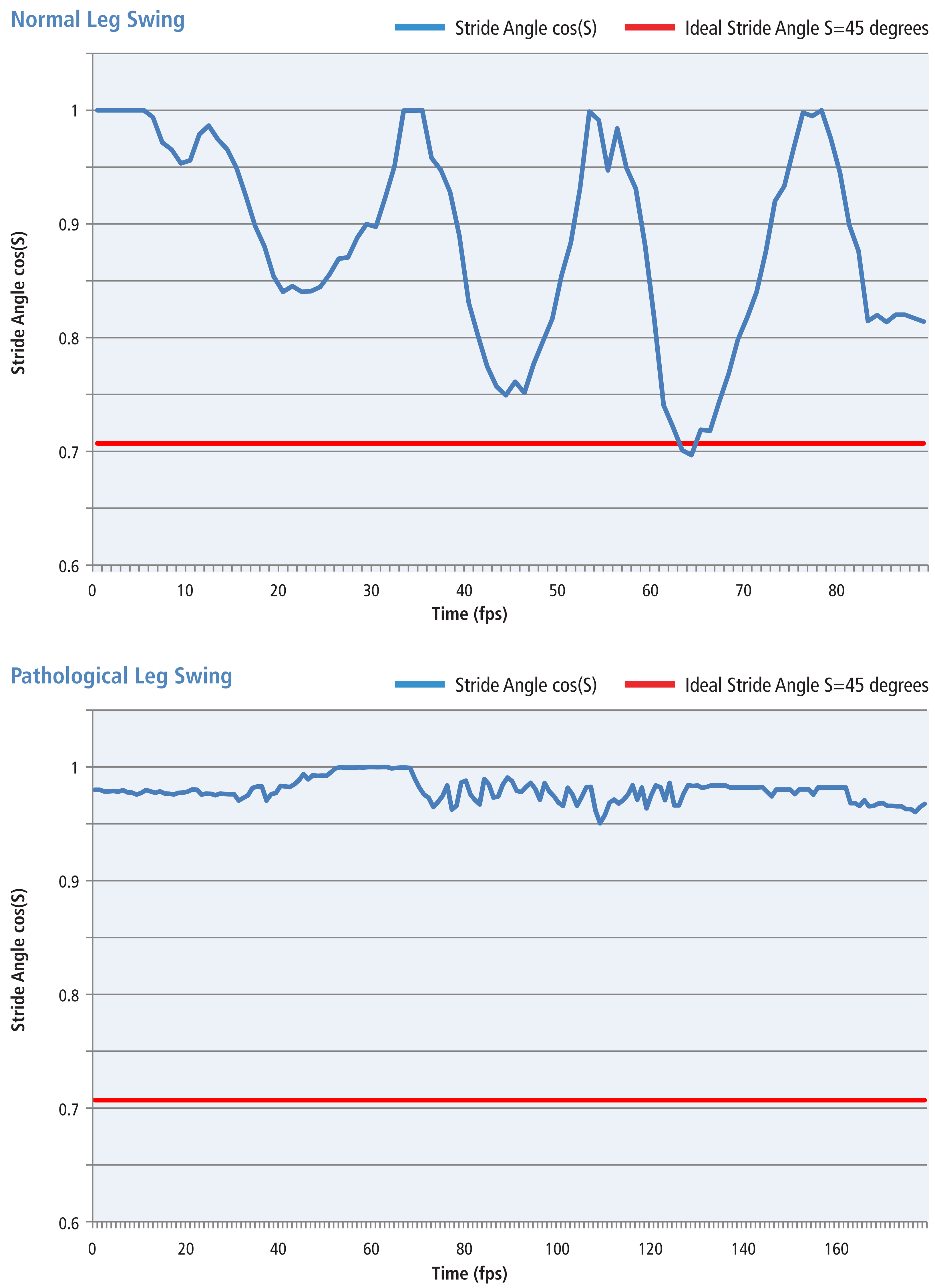


a. Normal Gait **b.** Parkinsonian Gait

Results

High cosine dissimilarity was observed in the stride and lean frequencies between PG and normal gait as depicted in figure 2 and 3 respectively. High variations are found in the stride intervals of PG whereas constant stride intervals are found in the normal gait.

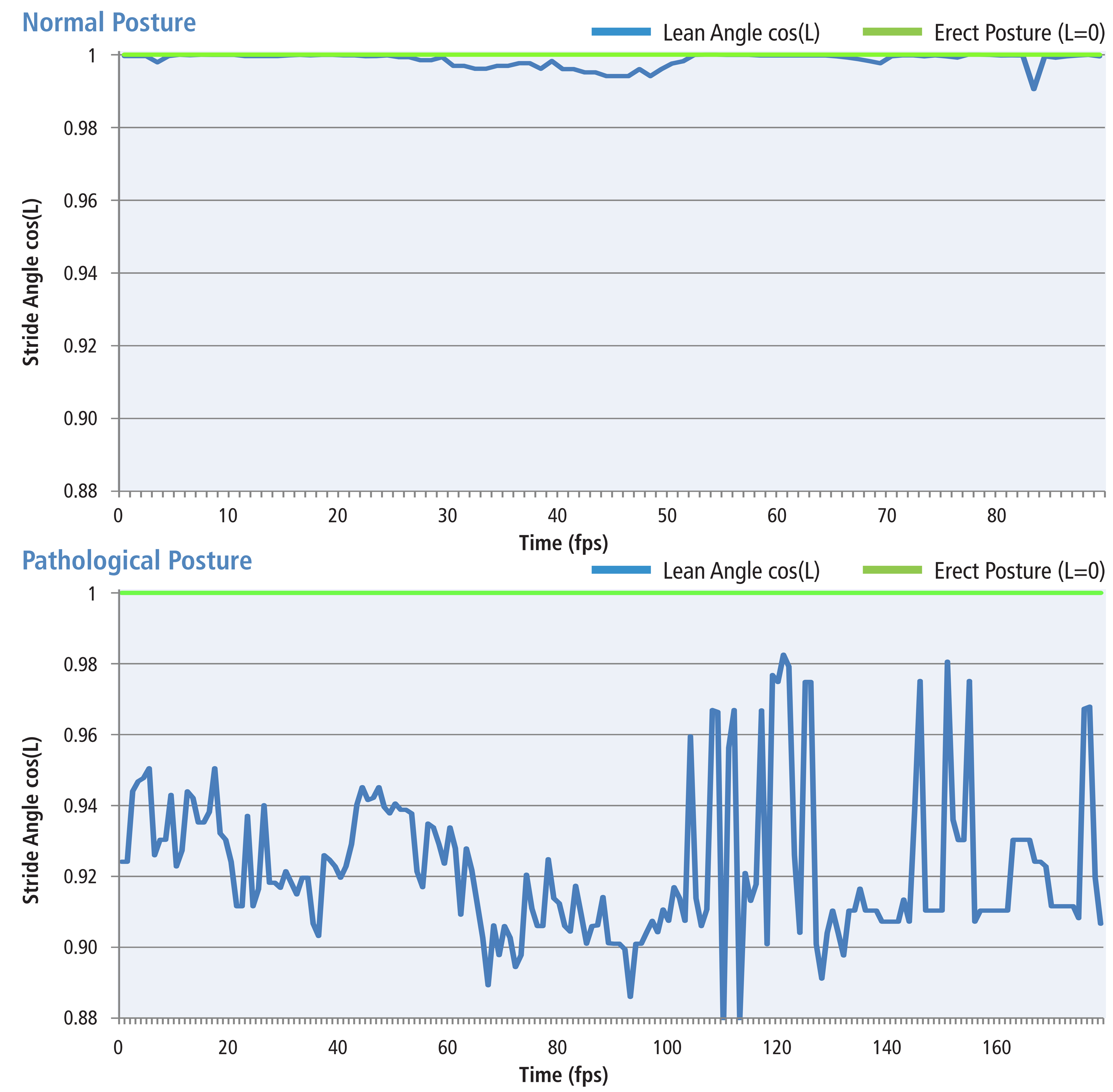
Figure 2.
A comparison between the Stride frequencies of a normal gait and a PG.



Conclusions

We propose an algorithm as a source to eliminate laboratory constraints and discomfort during PG analysis. Installing this tool in a home computer with a webcam allows assessment of gait in the home-environment.

Figure 3.
A comparison between the Lean frequencies of a normal gait and a PG.



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