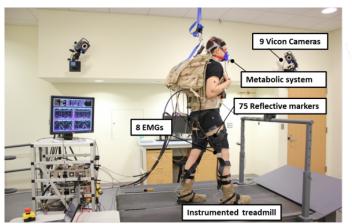
Gait Event Detection Using an LSTM Network 10-701 Project Presentation

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Introduction



from http://biodesign.seas.harvard.edu/soft-exosuits

Goal: Accurately detect gait events (heel strike, toe off) in video-based motion capture data of human walking gait

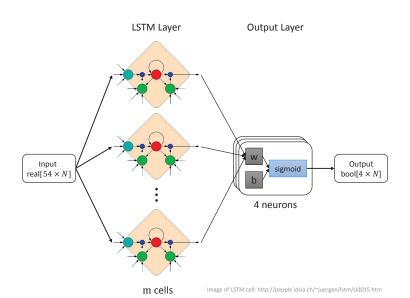
Introduction

- ▶ Problem: Sequence labeling
 - ▶ Input: 3D locus of 18 motion capture markers (54*N reals)
 - ▶ Output: {Left, Right} × {Heel Strike, Toe Off} (4*N bools)
- Dataset:
 - ▶ 8 subjects × 3 trials × 10 000 samples @ 100 Hz
 - Ground truth from force plates on treadmills

Our Approach

- Objectives:
 - ► Empirical feature-engineering should be minimal
 - Number of manually-picked parameters (window size, threshold, filter cutoff, etc.) should be minimal
 - Dependence of one gait cycle on those preceding it should be exploited
- Proposed solution: LSTM-based RNN
 - Recognition of quasi-periodic patterns even in presense of input noise
 - Robust and precise learning of rhythmic timing

Network architecture



Implementation

- ► Torch/Lua on AWS EC2 GPU instance (g2.2xlarge)
- Use LSTM code example by de Freitas (Oxford/Google)
 - Adapt to our input/output
 - Does not converge out of the box
 - ► Tweaks: Learning rate, mini-batch, regularization, etc.

Results

	devia	tion	mistak	mistake	
	mean	std	mean	std	
Foot velocity	4.84	3.74	2260.2	560.4	
Feed-forward NN	0.85	1.48	211.1	204.5	
LSTM	2.35	3.87	306.6	360.5	

Table 1: Comparison of results for N = 30, T = 2.5 s.

Results

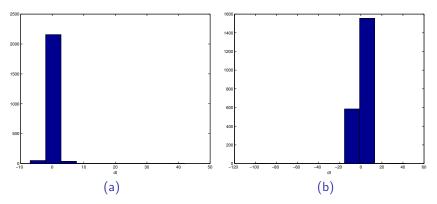


Figure 1: Histogram of deviation for Feed-forward NN (a) and LSTM (b).

Thank you for your attention!

Human Gait Cycle

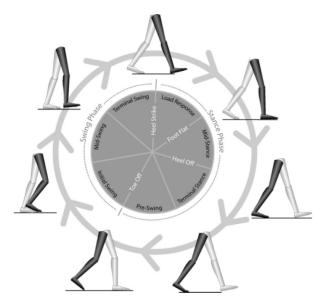


Figure 2: Gait events [Rueterbories et al., 2010] Figure 2: Gait events