

Can metronomes be used in gait training to improve gait symmetry of lower-limb amputees?

Development and Validation of Rhythmic Stimulation Biofeedback Gait Training System

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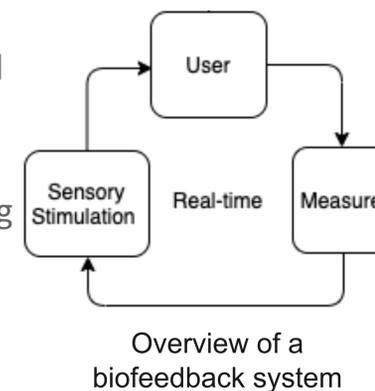
Introduction

Biofeedback (BFB) provides users with real-time feedback that can elicit changes in gait patterns. Major gaps:

1. Rhythmic stimulation for lower-limb amputee gait training (proven to improve temporal gait symmetry and maintain cadence for other clinical groups) [1]
2. Integrating rhythmic stimulation (audio metronome) with BFB.

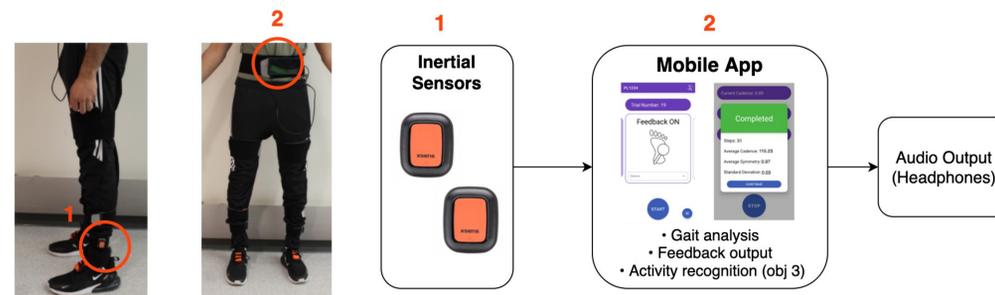
Objectives

1. Develop a wearable BFB system to measure real-time gait symmetry and provide feedback.
2. Validate the use of rhythmic stimulation to elicit gait changes using different BFB strategies.
3. Identify and characterize overall gait changes during training targeting stance-time symmetry).



Methods

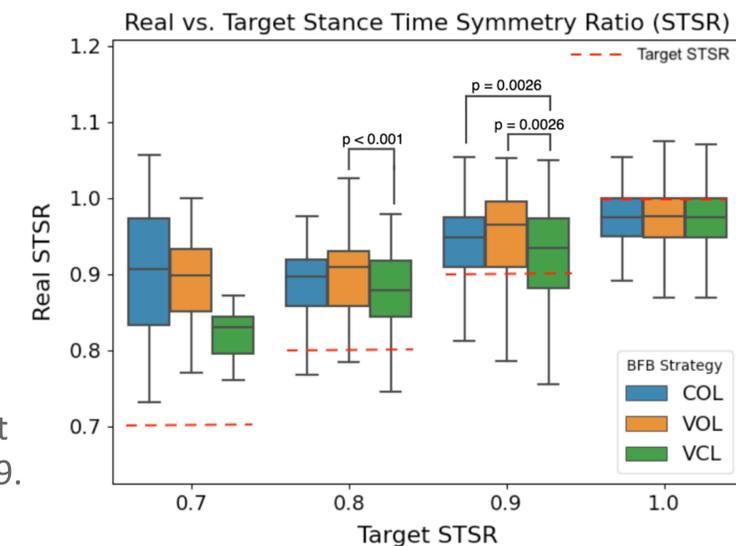
- Validate performance of wearable BFB system (developed mobile-app) targeting *stance-time symmetry ratio* (STSR)
- Constant and variable (incremental changes) rhythmic stimulation tested
- Participants: able-bodied control (n=10)



BFB Strategy	Description
Constant Open Loop (COL)	Target STSR remains constant .
Variable Open Loop (VOL)	Target STSR decreases every full gait cycle.
Variable Closed Loop (VCL)	Target STSR decreases only when participant achieves the current target.

Results

- All strategies elicited gait asymmetry.
- VCL performed significantly different compared to COL and VOL at target = 0.8, 0.9.



Significance & Impact

- Biofeedback can help reinforce good gait habits
- Rhythmic stimulation can elicit temporal symmetry changes while maintaining cadence (critical for gait rehabilitation)

Next Steps

1. Identify and characterize other gait changes (speed, kinematics, etc.)
2. Test and validate system with LLA (n=10) and conduct analysis

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References

[1] A. Michelini and J. Andrysek, "Evaluating the Effectiveness of Rhythmic Vibrotactile and Auditory Stimulation for a Biofeedback Gait Training System for Individuals with Lower Limb Amputation," *Canadian Prosthetics & Orthotics Journal*, 2021.

*This research study was approved by the Research Ethics Board at the Holland Bloorview Kids Rehabilitation Hospital, Canada. (REB-0448).

