



Biofeedback and Exoskeleton Assistance for Gait Therapy in Children with Walking Impairments



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Motivation & Background

Walking disability Lack of physical, social, & mental development^{2,3}

Potential long term mobility loss

Neurological diagnoses in kids can result in decreased mobility and impairment in walking

 Current Interventions (Surgical, Botox, Physical Therapy) do not always show long-term effects and can be time consuming and impose a clinical burden¹ We aim to investigate how biofeedback can be coupled with exoskeleton training to improve rehabilitation outcomes

Methods and Approach

Biofeedback Game

Targets
Player
Boundary
Knee angle

Time

Score: 751

Time

Score: 751

Time

Exoskeleton Assist



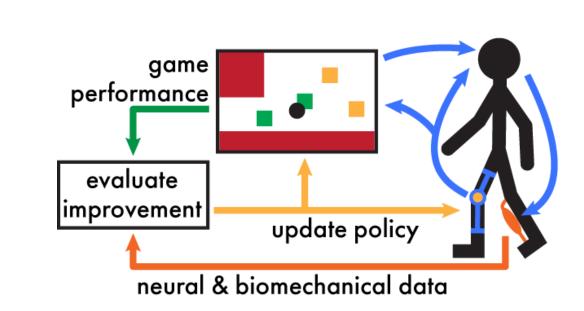
- N=7 Subjects
- Crouch Gait or Genu Recurvatum
- 5 training sessions,
 30 minutes
- Kinematic and EMG data collected

- Blocks indicate targeted knee ankles. Walls indicate regions of hyperflexion/extension
- Challenge level was tuned per subject
- Exoskeleton provided "assist as needed"
- Torque provided was proportional to error once knee angle deviated out of threshold

Results Biofeedback coupled with Exoskeleton Assistance shows improvements in multiple subjects post-training (degrees) Stance improvement retained on final visit Improvement not carried over to last visit Angle Joint Knee Gait Phase (%) Gait Phase (%) Improvements on multiple visits Better together: Improved engagement & Manual exo guidance Biofeedback Off 60 - Exo Off Baseline Final Training Post Training ●S1 (CG) ●S2 (CG) ●S3 (GR) ●S4 (GR) ●S5 (GR) Motor control complexity improves during training Representative hyper-extension and crouch gait subjects **But retention** inconsistent

Future Goals

Personalization of rehabilitation parameters through online optimization



References

- [1] Galey SA, et al. 2017 Gait and Posture
- [2] D. C. Johnson et al. 1997 J. Ped Ortho
- [3] M. Bottos et al. 2003 Dev Med & Child Neuro
- [4] D. Lee et al. 2023 IEEE Trans Biomed Eng

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