Obstacle Avoidance Training Using Fully Immersive Virtual Reality

Nachum Twersky, Fitsum Petros, Dr. Sunil K. Agrawal

**Motivation**

- At least 36 million falls occur within the elderly population each year resulting in at least 32,000 deaths.
- Many of these falls are due to an improper shift of balance or trip.
- Clinicians have created obstacle avoidance trainings and tests to help elderly individuals to deal with obstacles in their path.
- The current standard for obstacle avoidance training is by using a treadmill. Which limits the subject to walking without a walking aid and walking in a straight line.

**Objectives**

- Create a fully immersive virtual reality obstacle avoidance exercise
- Be able to quantify improvements in gait velocity, gait variance and step optimization
- Obstacles must be maneuverable and changeable to allow for maximum flexibility

**Methods**

- Using Unity 3D to create the virtual obstacle course
- Subjects will wear the VR headset and VR trackers on their feet
- Subjects would walk along an instrumented mat for 8 laps and step over the obstacles
- The Parameters that are being quantified and analyzed for changes are:
  - Gait Velocity
  - Gait Variance
  - Height Clearance

**Results**

- Baseline Walk
  - Clear continuous gait pattern
  - Even foot spacing
  - Even toe-off and heel-strike

- Optimized OAT Gait
  - Clear continuous stepping pattern
  - Uneven toe-off and heel-strike
  - Continuous Gait

- Unoptimized OAT Gait
  - Unclear stepping pattern (stutter step)
  - Non-Continuous gait
  - Uneven foot spacing

**Conclusion-Future Work**

- Fully immersive Virtual Reality, when paired with the trackers, can be used successfully for obstacle avoidance training
- Trackers can be used to quantify improvements and optimization in subjects walking patterns
- Use the flexibility of design for elderly subjects, subjects with walking aids or subjects with Parkinson’s Disease
- Test effectiveness of training where the subject must turn around curves or walk in any direction

**Acknowledgments and Resources**

Thank you to Columbia University and Amazon for including me in this amazing program! I am so grateful for Professor Agrawal and Fitsum Petros for mentoring me through these 10 weeks. Their guidance and patience afforded me a broader perspective of engineering research.

- https://www.rcra.org/article/get-the-facts-on-falls-prevention
- https://www.cdc.gov/falls/index.html