Over 35% of Americans suffer from balance disorders [1]. Improved quantitative and low cost analysis of these disorders is necessary. The goal of this project is to develop a solution to the problems of expensive equipment and lack of quantitative data in balance assessments using smart phone sensors. The project aims to improve upon existing standing balance testing and validate a system for dynamic testing. Smart phone technology has proven to be promising using more sophisticated, nonlinear analysis and in the use of dynamic testing. This experiment has expanded current systems to assess dynamic walking balance, which may have increased relevance to risk of falls. Previous research has shown the potential for smart phone sensors to collect continuous data to diagnose balance disorders, however, validation and more sophisticated sensor fusion is lacking [4]. We believe a low cost, accessible, yet sophisticated system can enhance the detection of balance problems and aid in early identification of risk and disorders. Future studies will investigate balance performance in unhealthy individuals. Future work will collect more subjects to establish healthy baseline data.

INTRODUCTION

• Over 35% of Americans suffer from balance disorders [1].
• Improved quantitative and low cost analysis of these disorders is necessary.
• The goal of this project is to develop a solution to the problems of expensive equipment and lack of quantitative data in balance assessments using smart phone sensors.
• The project aims to improve upon existing standing balance testing and validate a system for dynamic testing.

METHODS

• A mobile application has been developed to walk the user through the six stances of the BESS balance test (Figure 1), as well as a six minute walking trial.
• The smart phone is strapped to the users waist and collects tri-axial acceleration and angular velocity data.

RESULTS

• Sample Entropy (SE), a non-linear method of quantifying static stability, is used to observe variability of the subjects’ static postural sway during each of the six BESS stances.
• Maximum Lyapunov exponents (LyE), a non-linear method of quantifying dynamic stability, are calculated to quantify dynamic movement from the six minute walking test.
• Balance data is analyzed external to the application using custom MATLAB code. The middle 30 seconds of walking data is analyzed to facilitate compare with similar studies [2].

Figure 1: The six conditions of the BESS Balance Test Protocol.

• The average greatest LyE, or least stability, was found in the medial-lateral direction (Figure 2).

DISCUSSION

• Smart phone technology has proven to be promising using more sophisticated, nonlinear analysis and in the use of dynamic testing.
• This experiment has expanded current systems to assess dynamic walking balance, which may have increased relevance to risk of falls.
• Previous research has shown the potential for smart phone sensors to collect continuous data to diagnose balance disorders, however, validation and more sophisticated sensor fusion is lacking [4].
• We believe a low cost, accessible, yet sophisticated system can enhance the detection of balance problems and aid in early identification of risk and disorders.
• Future studies will investigate balance performance in unhealthy individuals.
• Future work will collect more subjects to establish healthy baseline data.

REFERENCES