

Intelligent Support of Gait Analysis

Kathy A. Johnson, Ph.D.*, Sheldon R. Simon, M.D.***, Philip J. Smith, Ph.D.***,
Jack W. Smith, M.D. Ph.D.*

*UT-Houston Dept. Health Informatics, **Beth-Israel Hospital NY,

***The Ohio State University, Dept. Industrial, Systems & Welding Engineering

Background. Gait analysis is the process of determining the cause of abnormalities in a patient's walking pattern so as to treat those abnormalities and improve the patient's functionality¹. A gait analysis session consists of several steps where information is collected about physical characteristics during an examination, and then quantitative data are collected about the patient's muscle activity, forces exerted and motion over time. All of the information is either collected by computer or entered into a computer and resides in electronic forms. In addition, most labs also record video of the patient walking. The results of a gait session are generally a set of printed reports from several sources as well as video of the patient. This data is then used to generate the gait analysis report and is also often used for teaching students to perform gait analysis.

Our goal is to develop a multimedia system for gait analysis to support both tutoring and report generation. For both purposes, one of the main functions needed is to draw a person's attention to pertinent pieces of information. Decision support tools can also aid both the clinician generating a report as well as the student learning to do the task.

System Description. Dr. Gait III is a multimedia system providing the means to view and electronically annotate all the information commonly present for gait analysis: medical history, physical examination, time/distance data, joint angle graphs, moments, powers, force plates, EMGs, video, and stick figures. It merges and expands upon two previous programs – pulling interface and

tutoring design from GAIT (Gait Analysis Interpretation Tool)², and basing its decision support tools on the tasks done in the knowledge-based system QUAWDS (QUalitative Analysis of Walking Disorders)³. The system uses data directly from the gait analysis laboratory – the only extra step being the digitization of video to create quicktime movies.

Data Annotation. Each screen of data may be annotated in a manner appropriate to the type of data. The style and color of text may be changed on textual screens. Graphical screens provide highlights to annotate a region of the graph and arrows to indicate a specific portion of a graph. For video data, each frame may be annotated with arrows and vectors of various colors.

Decision Support. QUAWDS broke the entire task of gait analysis into several steps: finding determination, muscle fault generation, muscle fault rating, and generation of explanatory coverage of muscle faults³. Decision support tools are being developed for each of these tasks. For example, the system can automatically annotate the graphs that are abnormal and generate text describing the problem for inclusion in a report.

Figure 1 shows an example of annotated graphs and the automatic text that can be generated from those graphs for inclusion in a report.

Conclusions. The system is in beta test. We are beginning evaluations of both the effectiveness of the tutoring system as well as the ease of use, ease of readability, and time-saving capabilities of the report generation system and the correctness of the decision support tools.

References

1. Inman, V.T., Ralston, H.J., & Todd, F. Human Walking. Baltimore: Williams & Wilkins; 1981.
2. Nippa, J. Development of a Computer-Based Multi-Media Tutoring System For Teaching Gait Analysis. [M.S. Thesis] Columbus, OH: The Ohio State University; 1992.
3. Weintraub, M.A., Bylander, T., & Simon, S.R. QUAWDS: a composite diagnostic system for gait analysis. Computer Methods and Programs in Biomedicine 1990; 32: 91-106.

