

## GGPSA: A GRAPHICS USER INTERFACE TO FILTER MOVEMENT ANALYSIS DATA

Giannis Giakas<sup>1</sup>, Gideon Ariel<sup>2</sup>

<sup>1</sup> SATRU, University of Manchester, Hope Hospital, Manchester, UK

<sup>2</sup> Ariel Dynamics, USA

Data filtering is a challenging procedure for the biomechanics scientists. It is however a fundamental part of biomechanical analysis when higher derivatives are needed to examine the movement. We present graphics user interface software specially designed to help biomechanics lecturers and students. It is openly designed to provide a powerful tool that could also be used for research purposes. Manual and automatic filtering procedures are provided along with single or batch processing of files. The program can process exported ASCII data files but also can be linked with the well-known APAS movement analysis program and read its binary files. Future work includes processing of many other binary files from other motion analysis systems.

**KEY WORDS:** data processing, filtering, GUI

**INTRODUCTION:** Data filtering is a relatively difficult subject to teach mainly because the students may not have a strong background in mathematics or physics. In addition we found that there is a strong need for a user-friendly software that lecturers and students could use in order to demonstrate immediately the effects of the various parameters of filtering to the data and their derivatives.

In this study we present a graphics user interface that fulfil the above but can also be used by researchers who want to filter their data with a good automatic filtering method, rather than using simple filtering methods implemented to their digitisation and analysis software.

**METHODS:** The software is using two interfaces. The main interface (Figure 1) is used to open the data file and go through its column of data or through the digitised positions. The users can select to use graphics or not depending on whether they wish to monitor the results and make adjustments to the parameters used for the automatic filtering which are controlled by the second interface (Figure 2). Obviously the lecturers or students who wish to understand the concept will use the graphics mode; Also researchers are strongly recommended to go through some initial experimentation with their data in order to make some initial adjustments to the best parameters for their measurements. When everything has been tested, the none-graphics mode can be used for batch processing of files. It is important to mention that a change of camera position or change of activity or anything else that will alter the general "pattern" of signal characteristics might need slightly modified parameters.

The frequency domain representation is generally used as the best way to examine filter characteristics, therefore this representation is a significant part of the in this program. We have also implemented a number of well-known digital filters (e.g. Butterworth, Chebyshev I and II, Elliptic), and different types of extrapolation (linear, reverse mirror, polynomial, prediction).

The algorithms used are based on published work of (DAmico and Ferrigno, 1990, DAmico and Ferrigno, 1992) and our work (Giakas and Baltzopoulos, 1997, Giakas and Baltzopoulos, 1997, Giakas, Baltzopoulos, 1998) in the development of the automatic calculation of the cut-off frequency based on signal characteristics. The graphics output can be modified by the user. The user can select all output data (unfiltered - filtered displacement, velocity, acceleration, and frequency domain) to be presented in one or separate windows. Figure 3 presents some data collected from a discus-throwing event.

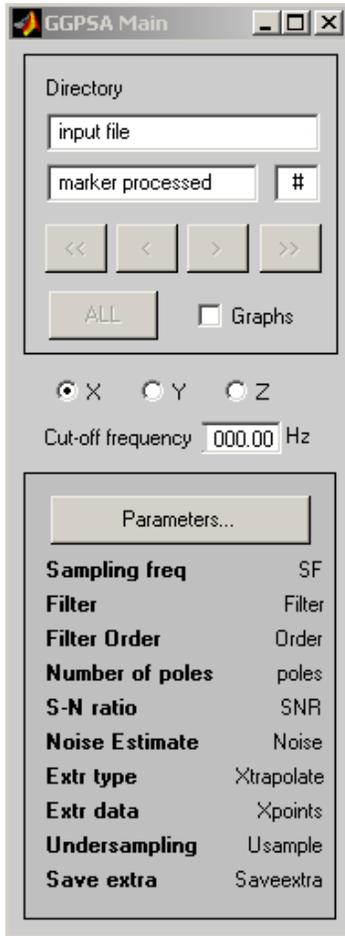


Figure 1 - The main interface.

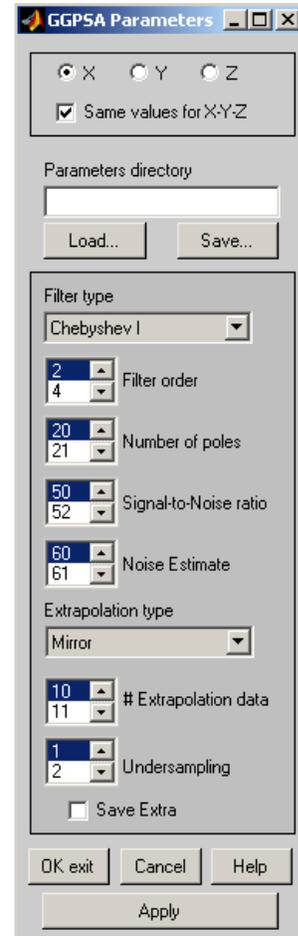


Figure 2 - The parameters interface.

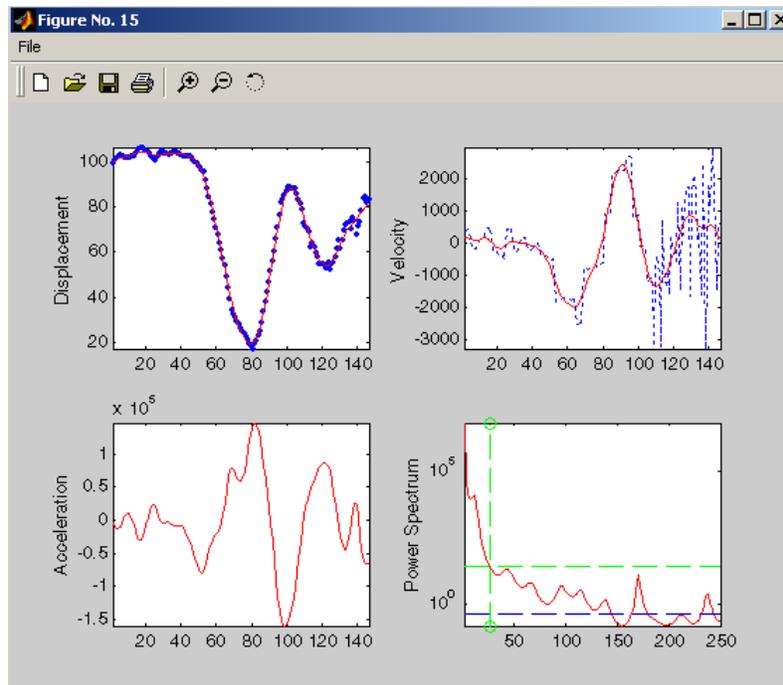


Figure 3 - Graphics output (all in one window).

**REFERENCES:**

D'Amico M Ferrigno G, Technique for the evaluation of derivatives from noisy biomechanical displacement data using a model-based-bandwidth-selection procedure. *Medical and Biological Engineering and Computing*, 28,407-415, 1990

D'Amico M Ferrigno G, Comparison between the more recent techniques for smoothing and derivative assessment in biomechanics. *Medical and Biological Engineering and Computing*, 30,193-204, 1992

[Giakas G Baltzopoulos V, Optimal digital filtering requires a different cut-off frequency strategy for the determination of the higher derivatives. *Journal of Biomechanics*, 30(8), 851-855, 1997

Giakas G Baltzopoulos V, A comparison of automatic filtering techniques applied to biomechanical walking data. *Journal of Biomechanics*, 30(5), 847-850, 1997

Giakas G, Baltzopoulos V Bartlett RM, Improved extrapolation techniques in recursive digital filtering: a comparison between least squares and linear prediction. *Journal of Biomechanics*, 31(1), 87-91, 1998