

# BioProc2

## Quick Reference Guide

by  
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### A. Installation

1. Get the file BPWIN2.zip. This file may be obtained from the following URL:  
<http://www.health.uottawa.ca/biomech/csb/software/bioproc2.htm>  
This software is provided free and may not be sold commercially.
2. If the archive does not open automatically open it with a program such as **WinZip** or **PowerArchiver** (<http://www.powerarchiver.com/>). Launch the **Setup.exe** file to begin the installation.
3. The program may have to reboot your system to upgrade certain Microsoft system files. This should not harm your operating system. The program is currently designed for use with Windows ME, 2000, NT and XP, with Windows 98 there can be serious problems when overwriting Visual Basic libraries. Keep a backup of the file, **msvbvm60.dll**. If your system cannot boot-up, copy this file back to the Windows system directory (usually C:\Windows\System32). The program may also find conflicts when installing various drivers. In general, press “Ignore” and “Yes”. Note, it is recommended to install the files to the directory “C:\Biomech” but this is not essential unless you plan to install the whole Biomech Motion Analysis System.
4. When newer versions of the program are available, just download the **BioProc2.exe** file to the appropriate directory (e.g., C:\Biomech) and start using it.

### B. Digital Signal Generator

1. Start **BioProc2**. Choose the Channel menu then the Generate Channels item. This form will generate many different types of waveforms. Generate the following waveforms: sine, square and triangle. To generate a waveform, click the down-arrow beside the words “select a wave.” Find the name of the waveform in the listbox and click it. The sampling rate should be 1000 Hz and the sample time one second, which can only be set when you generate the first waveform. Then press the Generate button to create the waveform.
2. After the first waveform is created, all subsequent waveforms must have the same sampling rate and duration. Note, each wave should have an amplitude of 1 (i.e., 2 peak-to-peak) and only one cycle. Since the sample time is one second the signals will all have frequencies of 1 hertz. After all the waveforms have been created, click the Exit button to return to the main menu.

## B. Digital Oscilloscope

1. Press the Graph button to view the waveforms graphically. Press the Sstats button to view descriptive statistics about each wave. Note that the maxima and minima are +1 and -1, respectively and the ranges are 2. These values correspond to the amplitudes of the generated waveforms. Notice that the means for the square and triangle waves is not zero. That is because there are actually 1001 data points in each waveform. The first 500 data in the square wave are 1s, the next 500 are -1s and the 1001<sup>st</sup> datum is 1. The average is therefore 1/1001 which rounds to 0.0010. A similar situation occurs for the triangle wave but since the sine wave starts and ends at zero, its mean is zero.
2. To confirm this, close the statistics window and the graph and press the Table button. These data will appear in tabular form. Notice that there are exactly 1001 data in each waveform. Exit this form.
3. Press the Integral Stats item under the Analysis menu to view various integral functions, including path integral, time integral, absolute time integral (integral of absolute values), sum and absolute sum. Note the sum and integral are the same because the sample time is one second. Pressing the Descriptive Stats button returns you to the descriptive statistics form. Exit these forms.
4. Press the Graph button again. To view a single wave, press the Select button. Uncheck all the check-boxes excepting the one labelled “sine” then press the OK button to view only the sine wave.
5. Press the pushbutton labelled Cursor. A moveable window will appear as well as a yellow vertical cursor. The pushbuttons control the function of the mouse. Moving the mouse in Cursor mode allows you to view the values of the waveforms under the cursor.
6. Press the Zoom pushbutton to allow you to zoom in on parts of the waveform. Selecting a point on the graph and dragging the mouse to another part of the graph enlarges the area between the two points. Zoom in on a small portion of the graph then press the Points button to see the locations of the individual data. To enlarge the points, select the Stars item under the Points menu. You can press the Pan pushbutton to move the data around with the mouse. Press the Reset button to reset the display.

## D. Digital Signal Processing

1. Click the Clear ALL channels item in the Channel menu to erase all waveforms from memory. Next, generate three 1-hertz sine waves of amplitude 1 and duration 3 seconds. Then generate random numbers of amplitude 0.0001 using the Noise waveform. Use the Add channel item to create a “noisy” sine wave by adding the sine and noise channels.
2. Erase the noise waveform and make a duplicate of the noisy sine wave. These functions are in the Channel menu (Duplicate Channel). You should now have three waveforms; one clean sine wave and two identical noisy sine waves.
3. Filter one of the noisy sine waves with a 1.0 Hz low-pass, zero-lag Butterworth filter. This filter is found in the Analysis menu under the item Low-pass filter. It can also be found in the Smoothing submenu under the item Digital filter. The peak amplitude should be reduced to approximately  $\pm 0.707$  (the cutoff point).

4. Erase the filtered sine wave and create another noisy sine wave by duplicating the unfiltered noisy sine wave (as in step 2 above).
5. Filter one of the noisy sine waves with a 2.0 Hz low-pass, zero-lag Butterworth filter. This cutoff frequency is above the true frequency of the sine wave and therefore should not greatly alter the characteristics of the sine wave.
6. Take two derivatives (i.e., accelerations) of all the waveforms. Time differentiation is done in the *Mathematical Functions* item of the *Analysis* menu. The true acceleration curve is the sine wave that was not contaminated by noise.
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8. Do a Fourier analysis of the three waveforms. Use the *Harmonic Regression* item in the *Analysis/Fourier Analysis* menu.
9. To print a graph of the curves or power spectra, hold the *Alt* key and press the *Print Screen* key when the graph is “in focus.” Open Wordpad, WordPerfect or Word and “paste” (*Ctrl-V*) the graph into a blank page. The image may then be edited and printed. Note, unless you have a colour printer, the graph will not be similar to the screen version.
10. Alternately, use the *Tab-delimited ASCII File* item in the *Save* menu and read the “.tab” file with Quattro Pro or Excel. These programs have excellent graphics features but be sure to use a format that plots the signals against time (first column in the .tab file).

## E. EMG Signal Processing

1. Load and display the EMG file, EMG-ES.dat. When asked to reduce the force platform data answer “No.” This file includes the EMGs from six muscles of the lower back during a constant submaximal contraction of one minute. The sampling rate was 400 hertz (Hz) per channel.
2. From the *Analysis/EMG Analysis* menu choose the *Fatigue Analysis* item. Choose a one second interval and select a channel to analyze. Run the analysis and view the results graphically and digital. Generally, researchers use the mean EMG frequency (vs. median) to determine when a fatigue state occurs. Does the mean EMG of the selected muscle drop below 70.7% of the initial mean frequency? This value called the “cutoff” point (half-power point) is a commonly used threshold in signal processing. Other values may be selected.
3. Load and display the file, EMG-FDL.bin. Note the differences among the six tracings. The first signal is a clean recording of the two contractions of the **flexor digitorum longus** muscle (a wrist flexor). The second waveform is the same signal with crosstalk from an ECG signal (this was created artificially). Perform a Fourier analysis of both signals (*Harmonic Analysis*) and notice the differences. Do the same for the third tracing which has 60 cycle (line frequency) interference added.
4. Use high-pass digital filtering to remove the movement artifact in tracing four. Select as a cutoff frequency 20 Hz. The same procedure could be used to remove the DC-bias of tracing five but subtracting 0.1707 will achieve better results. This may be done from the *Analysis/Bias Removal* menu and the item *Term*.

## F. Force Platform Signal Processing

1. Load and display the file WALK.dat. These are the signals from a **Kistler** force platform as collected by **BioWare 2.2** software. Note, the program identifies that the file contains force platform data and requests a threshold, below which it is assumed that the forces are caused by noise or room vibrations.
2. Use the Analysis/Analyze Force Plate Data menu and choose the Show Plate Parameters item to see which type of platform was used. Then choose the Combine Two Plates to add the two platforms' data together to produce a combined ground reaction force. Press the Graph button to view the data. Note that the second plate's data are still in the file but the first plate's data have been replaced.
3. Load the file JUMP.dat. From the Analysis/Analyze Force Plate Data menu choose Centre of Gravity then press the Average button to compute the person's body weight. Next, press the To Airborne button to have the computations stop when the person leaves the platform after the jump. Lastly, press the 5. *Compute C. of G.* button to compute the takeoff velocity, takeoff height and the work and power produced during the jump, among other parameters.

## G. Additional Features

1. Amplitude Probability Distribution Function (APDF) and Cumulative APDF. Found in EMG submenu. Used for evaluating workplace activities.
2. Import functions. These include, space, comma and tab-delimited ASCII files and **Kin-Com**, **BioBench** and **Motion Analysis** ASCII files plus binary formats, such as, **BioWare** and **APAS** analog and **Motion Analysis** binary formats.
3. Export formats. Various ASCII formats and for force platform data, Biomech Motion Analysis Reduced Force (.RF) and a discrete Fourier transform (.FTF) format.
4. **BioProc** ( DOS version) can perform ensemble averaging.
5. Correlation. Pearson correlation of two channels and auto- or cross-correlation functions.
6. Channel functions: add, multiply, square root, duplicate, hypotenuse
7. Mathematical functions: subtract, multiply or divided by a constant, path length, invert
8. Signal reconstruction: polynomial fitting, Shannon reconstruction, time-base normalization.