

Order of Records from the BIOMECH Programs

(Last revised: 21 October 2004)

All of the programs in the Biomech Motion Analysis System have optional disk file output for the results of their computations. The following text outlines the order of the output records from each file. The programs write the data in unformatted binary records.

Index of Biomech Binary Output data Files

File extension	Program	Description
<u>.AV</u>	<u>AVERAGE</u>	ensemble averages and confidence intervals
<u>.EN</u>	<u>ENERGY</u>	total body & segmental energies
<u>.FO</u>	<u>FORCE</u>	joint forces and moments of force
<u>.FR</u>	<u>FOURIER</u>	Fourier reconstructed coordinates
<u>.JP</u>	<u>FORCE</u>	joint moments and powers
<u>.KM</u>	<u>KINEMATIC</u>	marker kinematics
<u>.KS</u>	<u>KINEMATIC</u>	segmental & total body kinematics
<u>.MM</u>	<u>MOMENTUM</u>	segmental & total body momenta
<u>.MU</u>	<u>MUSCLE</u>	muscle length kinematics
<u>.NS</u>	<u>NOISE</u>	noise analysis (similar to Fourier)
<u>.PJ</u>	<u>POWERS</u>	joint powers etc.
<u>.PS</u>	<u>POWERS</u>	segmental powers etc.
<u>.RA</u>	<u>KINEMATIC</u>	relative angular kinematics

The following Biomech output files are NOT binary data files:

<u>.DG*</u>	Imager	unscaled digitizer coordinates
<u>.CN†</u>	CINEDATA	unfiltered marker coordinates
<u>.DR†</u>	KINEMATIC	changes in relative angles
<u>.RF‡</u>	BioProc2	reaction force data from force plate
<u>.SN†</u>	SIMULATE	simulation marker coordinates

* This file cannot be read directly by BioProc2. It can be converted to .CN format by the Cinedata program.

† These files are in ASCII format. They can be read with ASCII parser within BioProc2.

‡ This file can be read directly by BioProc2.

APPENDIX A

AVERAGE PROGRAM

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.AV file

The ordering of records created by the Average program depend upon which files and which records were selected for averaging. They are not predefined. For each record that was averaged four new records are created: one is the mean, the next is the standard deviation, and the last two are the mean minus and plus the confidence interval selected during the averaging process (95th, 99th or 1 or 2 standard deviations, etc.) Usually there are 101 elements in each curve (i.e., 0 to 100%). The file begins with two records that may be ignored. The second can be used as the data for the abscissa.

RECORD	DATA
1	Program information about number of records.
2	Abscissa in percentages (%)
3	Curve 1, mean
4	Curve 1, standard deviation
5	Curve 1, mean minus confidence interval
6	Curve 1, mean plus confidence interval
7-10	Curve 2, repeated as above
11-14	Curve 3, repeated as above
etc.	

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ENERGY PROGRAM

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.EN file

Option(31)=1 means ENERGY will write segment mechanical energies to a disk file with extension, .EN, in the following order:

RECORD	DATA
1	Total body mechanical energy (J)
2	Segment 1, translational kinetic energy (J)
3	Segment 1, rotational kinetic energy (J)
4	Segment 1, potential energy (J)
5	Segment 1, total segment energy (J)
6-9	Segment 2, repeated as above
10-13	Segment 3, repeated as above
etc.	

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APPENDIX C

FORCE PROGRAM

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.FO file

Option(53)=1 means FORCE will write net forces and moments of force to a disk file with extension, .FO, in the following order. FORCE computes joint forces in the order specified in your BIOMECH control file. Note, if a support moment is computed it is the tenth record after the three joints of the lower extremity.

RECORD	DATA
1	Segment 1, proximal joint force, X (N)
2	Segment 1, proximal joint force, Y (N)
3	Segment 1, proximal joint moment of force (N.m)
4-6	Segment 2, repeated as above
7-9	Segment 3, repeated as above
10	Possibly the support moment
10-12	Segment 4, repeated as for segment 3
etc.*	

* Note, if there are only three connected segments the last two records are the support moment's according to Winter and then Hof.

.JP file

Option(71)=1 means FORCE will write the joint angular velocities, net moments of force and the power produced by the moments of force to a disk file with extension, .JP, in the following order:

RECORD	DATA
1	Joint 1, angular velocity (rad/s)
2	Joint 1, net moment of force (N.m)
3	Joint 1, power of net moment of force (W)
4-6	Joint 2, repeated as above
7-9	Joint 3, repeated as above
etc.	

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FOURIER and NOISE PROGRAMS

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.FR and .NS file

Option(2) (column # 2=0) means FOURIER or NOISE will write reconstructed data to a disk file with extension, .FR or .NS, for plotting purposes. FOURIER and NOISE essentially reconstruct the digitized data for the Imager or FIGURE programs, with the data smoothed by reconstruction with the harmonic frequencies defined by Option(1) in the Biomech control file. The number of body markers processed depends on the markers selected in the control file. See Biomech User's Manual for details.

NOPTNS column number and selected output order for FOURIER or NOISE follow:

RECORD	DATA
1	Fourier marker 1, X data adjusted (slope removed, cm)
2	" " 1, X data reconstructed from Fourier series
3	" " 1, Y data adjusted (slope removed, cm)
4	" " 1, Y data reconstructed from Fourier series
5-8	Fourier marker 2, repeated as above
etc.	

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APPENDIX E

KINEMATIC PROGRAM

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.KM file

Option(12)=1 means KINEMATIC will write marker kinematics to a disk file with extension, .KM, in the following order:

RECORD	DATA
1	Marker 1, position, X-coordinate
2	Marker 1, position, Y-coordinate
3	Marker 1, velocity, X
4	Marker 1, velocity, Y
5	Marker 1, acceleration X
6	Marker 1, acceleration Y
7-12	Marker 2, repeated as above
13-18	Marker 3, repeated as above
etc.	

Marker 2 data begins at record 7, Marker 3 at record 13, etc.

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.KS file

Option(11)=1 means KINEMATIC will write records of segment kinematics for those specified in your control file to a disk file with extension, .KS, in the following order:

RECORD	DATA
1	Time array, based upon sampling rate and initial time
2	Total body centre of gravity, X-coordinate
3	Total body centre of gravity, Y-coordinate
4	Total body c. of g. velocity, X direction
5	Total body c. of g. velocity, Y direction
6	Total body c. of g. acceleration, X direction
7	Total body c. of g. acceleration, Y direction
8	Total body c. of g. mech. energy
9	Percent of time elapsed
10	Repeat of (9)

The order of the following records repeats for each defined segment.

11	Segment 1, position of c of g, X (m)
12	Segment 1, position of c of g, Y (m)
13	Segment 1, absolute angle (rad)
14	Segment 1, velocity of c of g, X (m/s)
15	Segment 1, velocity of C of G, Y (m/s)
16	Segment 1, angular velocity (rad/s)
17	Segment 1, acceleration of C of G, X (m/s ²)
18	Segment 1, acceleration of C of G, Y (m/s ²)

19	Segment 1, angular acceleration (rad/s ²)
20-28	Segment 2, repeated as above
29-37	Segment 3, repeated as above
etc.	

Segment 2 begins at record 20. A good way to track down which record you wish to plot out of this or any file, is to create a table, i.e.,

Segment	Foot	Shank	Thigh
CGX	11	20	29
CGY	12	21	30
ANGLE	13	22	31
VX	14	23	32
VY	15	24	33
OMEGA	16	25	34
AX	17	26	35
AY	18	27	36
ALPHA	19	28	37

The length of any of these files depends upon the number of segments, as the BIOMECH package programs with this type of output loop through the “unformatted writes” once for each segment under scrutiny.

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.RA file

Option(10) (column 10=0) means KINEMATIC will write the angular kinematics for the joints specified in your control file to a disk file with extension, .RA, in the following order:

RECORD	DATA
1	Joint 1, relative angle (rad)
2	Joint 1, relative angular velocity (rad/s)
3	Joint 1, relative angular acceleration (rad/s ²)
4-6	Joint 2, repeated as above
7-9	Joint 3, repeated as above
etc.	

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APPENDIX F

MOMENTUM PROGRAM

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.MM file

Option(41)=1 means MOMENTUM will write segmental and total body momenta to a disk file with extension, .MM, in the following order:

RECORD	DATA
1	Segment 1, momentum, X (kg.m/s)
2	Segment 1, momentum, Y (kg.m/s)
3	Segment 1, total angular momentum (kg.m ² /s)
4-6	Segment 2, repeated as above
7-9	Segment 3, repeated as above
etc.	

Data records for Segment 2 begin at Record 4. The last five records in the MOMENTUM output disk file are for total body computations:

RECORD	DATA
n+1	Total body momentum, X (kg.m/s)
n+2	Total body momentum, Y (kg.m/s)
n+3	Total body angular momentum (kg.m ² /s)
n+4	Total body moment of inertia (kg.m ²)
n+5	Total body angular velocity (rad/s)

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MUSCLE PROGRAM

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.MU file

MUSCLE will write muscle length kinematics to a disk file with extension, .MU, in the following order:

RECORD	DATA
1	Gastrocnemius, length (cm)
2	Gastrocnemius, velocity of shortening (cm/s)
3	Gastrocnemius, acceleration (cm/s ²)
4-6	Soleus, repeated as above
7-9	Semimembranosus, repeated as above
10-12	Vastus lateralis, repeated as above
13-15	Rectus femoris, repeated as above
16-18	Tibialis anterior, repeated as above
19-21	Gluteus maximus, repeated as above
21-24	Semitendinosus, repeated as above
25-27	Biceps femoris, repeated as above

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APPENDIX H

POWERS PROGRAM

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.PS file

Option(64)=1 means POWERS will write segment powers to a disk file with extension, .PS, in the following order:

RECORD	DATA
1	Segment 1, distal joint power (W)
2	Segment 1, muscle power at distal joint (W)
3	Segment 1, joint power at proximal joint (W)
4	Segment 1, muscle power at proximal joint (W)
5	Segment 1, total power (W)
6	Segment 1, mech. energy, rate of change (W)
7	Segment 1, difference between (6) and (5) (W)
7-14	Segment 2, repeated as above
15-21	Segment 3, repeated as above
etc.	

Option(64)=1 and Option(66)=1 means POWERS will write trunk powers to the end of the segmental power records, in the same order. Thus, if you wish to plot data from the trunk segment, you must count records through the segments to the trunk. Note, if Option(66)=0 POWERS will neither compute nor write the trunk powers. If Option(64) is not equal to 1, segmental powers will not be stored on a disk, POWERS only writes segmental powers to disk if you analyze every frame.

Option(62)=1 means POWERS will calculate and write to disk file total body power records. These will write on the end of the same disk file as the segmental and trunk power records. You must be aware of what output options you have specified to keep track of the record listing. The total body records will write at the end of the segmental listing if Option(66)=1, and at the end of the trunk records if Option(66)=1. Total body power records:

RECORD	DATA
n+1	Total body power (W)
n+2	Total body rate of change of energy (W)
n+3	Total body difference (W)
n+4	Total body “ideal difference” (W)

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.PJ file

Option(65)=1 means POWERS will write joint power records to a disk file with extension, .PJ, in the following order:

RECORD	DATA
1	Proximal joint of seg. 1, joint angle (rad)
2	Proximal joint of seg. 1, joint angular vel. (rad/s)
3	Proximal joint of seg. 1, X linear vel. (m/s)
4	Proximal joint of seg. 1, Y linear vel. (m/s)
5	Proximal joint of seg. 1, X net force (N)
6	Proximal joint of seg. 1, Y net force (N)
7	Proximal joint of seg. 1, net moment (N.m)
8	Proximal joint of seg. 1, power transferred through joint (W)
9	Proximal joint of seg. 1, power transferred by moment (W)
10	Proximal joint of seg. 1, power of net moment (W)
11-20	Proximal joint of seg. 2, repeated as above
21-30	Proximal joint of seg. 3, repeated as above
etc.	

If the last segment is the trunk, there will be no associated records since it is connected to one or more of the other segments. For further clarification of this record listing, run POWERS with Option(63)=1, and examine the joint power listings.

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