



Description of database to store experimental biodynamic data and definition of data to be stored in the common database

**Appendix W3C to Final Report
May 2001**

EC Biomed II concerted action BMH4-CT98-3251

WORK PACKAGE WP3W REPORT

Task: Design of a data base to collect existing data of human experiments and provide experimental data to be stored in the common data base

1. General structure of the database

The ACCESS database is intended to hold comparative experimental results from partners of the VINET (FIOASH, ISVR, NIWL). It also provides a tool for archiving data from future experiments in a common format.

Section 1 describes the information that is stored in the ACCESS database itself. Experimental (time history) data are stored in separate files, the pathnames of which are contained in the ACCESS database. The structure of the data files is shown in Section 2. Section 3 shows some proposed functions (launched from the ACCESS database) to import and export data, and to perform summary analyses.

2. ENTERING DATA

2.1 *Viewing experimental details*

When the database file (WP3W.mdb) is opened, the main form (referred to as "Control Panel") shows details of the last experiment entered (i.e. the last record in the "Experiments" table).

Control Panel

Vibration Injury Network biodynamic database Experiment record #: 3 v1.0

Description of Experiment

Reference number: IS1

Laboratory and Institute: Human Factors Research Unit, ISVR, University of Southampton, SD17 1BJ, UK

Short description of experiment: The dynamic responses of eight male subjects exposed to vertical whole-body vibration have been measured at eight locations of the body in three directions within the sagittal plane: in the vertical, fore-and-aft and pitch axes. The motions were measured on the body surface at the first, fifth and tenth thoracic vertebra (T1, T5, T10), at the first, third and fifth lumbar vertebra (L1, L3, L5) and at the pelvis (the posterior-superior iliac spine), and were corrected so as to estimate the motions of the skeleton. The head motion was measured with a bite-bar. The force

Start date:

Finish date:

Entry date: 01 February 2001

New Experiment **Show / Find Experiment**

Experimental Conditions

| Description of Experimental Condition | Seat | Posture | Motion |
|---------------------------------------|----------------|-----------------|----------------------|
| Low magnitude | Hard flat seat | Upright posture | 0.5 m/s ² |
| High magnitude | Hard flat seat | Upright posture | 1.0 m/s ² |

New Condition **Show Seats** **Show Postures** **Show Motions**

Measurements and data files

| Full Pathname of Data File | Channel Offset | Subject Reference | Experimental Condition |
|----------------------------|----------------|-------------------|------------------------|
| data\IS1\VS1.das | 0 | S1 | Low magnitude |
| data\IS1\VS1.das | 6 | S1 | High magnitude |
| data\IS1\VS2.das | 0 | S2 | Low magnitude |
| data\IS1\VS2.das | 6 | S2 | High magnitude |
| data\IS1\VS3.das | 0 | S3 | Low magnitude |
| data\IS1\VS3.das | 6 | S3 | High magnitude |

New Data Set **Show Subjects** **Show Measurements**

Record: 1 of 1

Exit Database

Some details of the experiment are shown in the left-hand (“Description of Experiment”) panel. These fields cannot be edited in this form. Use the navigation buttons (in the bottom left of the form window) to move to another experiment in the database. To view more information about the experiment shown in the main form (i.e. the “current experiment”), click “Show/Find Experiment”.

Experiments

Details of current experiment Experiment record #: 3

Reference number: IS1

Laboratory and Institute: Human Factors Research Unit, ISVR, University of Southampton, SD17 1BJ, UK

Start date:

Finish date:

Entry date: 01 February 2001

Experimenters: Y. Matsumoto, M.J. Griffin

Details of shaker and other equipment: 1m vertical electrohydraulic shaker.

Short description of experiment: The dynamic responses of eight male subjects exposed to vertical whole-body vibration have been measured at eight locations of the body in three directions within the sagittal plane: in the vertical, fore-and-aft and pitch axes. The motions were measured on the body surface at the first, fifth and tenth thoracic vertebra (T1, T5, T10), at the first, third and fifth lumbar vertebra (L1, L3, L5) and at the pelvis (the posterior-superior iliac spine), and were corrected so as to estimate the motions of the skeleton. The head motion was measured with a bite-bar. The force at the seat surface was also measured. The subjects were exposed to vertical random vibration in the frequency range from 0.5 to 20 Hz at a magnitude of 1.0 ms⁻² r.m.s. The movement of the upper body at the principal resonance frequency of the driving-point apparent mass is illustrated using the transmissibilities from seat vertical vibration to vertical and fore-and-aft

References: Matsumoto, Y., Griffin, M. J. (1998) Movement of the upper-body of seated subjects exposed to vertical whole-body vibration at the principal resonance frequency. Journal of Sound and Vibration, 215 (4), 743-762.

Find Experiment **Del Experiment** **Undo** **Close**

Record: 1 of 1

The top right-hand panel of the Control Panel shows a list of experimental conditions, each consisting of the displayed combination of seating condition, posture condition and motion

condition. To view full details of all the seating, posture and motion conditions in the current experiment, click on the relevant button at the bottom of the upper right-hand panel.

The image shows two screenshots of software panels. The top panel is titled 'Seats' and 'Seating conditions'. It includes fields for 'Experiment record #' (3) and 'Seat record #' (3). A 'Short description of seat' field contains 'Hard flat seat'. Below this are checkboxes for 'Seat cushion?' and 'Backrest?', and input fields for 'Height of seat surface', 'Depth of seat surface', 'Angle of seat from horizontal', 'Height of backrest', and 'Angle of backrest from vertical'. A 'Photograph of seat' field is empty. An 'Any additional information' field contains 'Hard flat seat with no backrest and no footrest (feet were unsupported)'. At the bottom are buttons for 'New / Edit', 'Delete', 'Undo', and 'Close', and a record navigation bar showing 'Record: 1 of 1'.

The bottom panel is titled 'Motions' and 'Motion conditions'. It includes fields for 'Experiment record #' (3) and 'Motion record #' (6). A 'Short description of motion' field contains '0.5 m/s²'. Below this are checkboxes for 'x-axis', 'y-axis', and 'z-axis' (checked), with corresponding 'r.m.s. acceleration' input fields. A 'roll' checkbox is also present. A 'pitch' checkbox is present. A 'yaw' checkbox is present. A 'frequency weighted according to' dropdown is set to 'unweighted'. A 'Spectrum' dropdown is set to 'Broad-band random'. 'Band limits - lower' is 0.0 Hz and 'upper' is 20.0 Hz. An 'Any other information' field is empty. At the bottom are buttons for 'New / Edit', 'Delete', 'Undo', and 'Close', and a record navigation bar showing 'Record: 1 of 2'.

The bottom right-hand panel shows the data file names (and directory path) containing the data for displayed combination of subject and experimental condition (referred to a a “data set”).

To view full details of all the subjects in the current experiment, click on the “Show Subjects” button at the bottom of the lower right-hand panel.

The image shows a screenshot of the 'Subjects' panel, titled 'Experimental Subjects'. It includes fields for 'Experiment record #' (3) and 'Subject record #' (2). A 'Subject reference' field contains 'S1'. Below this are input fields for 'Name', 'Age' (33 years), 'Body mass' (63 kg), and 'Any other information'. There are radio buttons for 'Gender' (male selected, female unselected). On the right side, there are input fields for 'Height to temples [KPH]', 'Height to shoulder [ACH]', 'Height to elbow [EBH]', 'Elbow joint width [EBB]', 'Hand breadth [HGB]', 'Knee joint width [KNB]', 'Ankle joint width [FGB]', 'Seated height', and 'Buttocks-knee length'. At the bottom are buttons for 'New / Edit', 'Del', 'Undo', and 'Close', and a record navigation bar showing 'Record: 1 of 4'.

To view specifications of the data stored in each channel of the data file , click on the “Show Measurements” button at the bottom of the lower right-hand panel.

2.2 To add a new experiment

Click “New Experiment” in the left-hand panel. This will open the “Experiments” form: enter details in all the relevant fields and click “Close”. When the control panel re-opens, nothing will be displayed in right-hand panels. Click “Show Seats”, then “New/Edit” and enter all relevant details of the first seating condition. Repeat for all further seating conditions used in the experiment the click “Close”. Enter details of all postural and motion conditions in a similar manner. When all seating, postural and motion conditions have been entered click “New Condition” and enter a label for each experimental condition. For each experimental condition select a seat, posture and motion condition in the respective list-boxes.

Click “Show Subjects”, then “New/Edit” and enter information about each subject then click “Close”. Enter definitions of each data channel in a similar manner. Click “New Data Set” and enter the data file pathname and channel offset for each data set in turn, and select the corresponding subject and experimental condition in the respective list boxes.

3. Definition of fields in ACCESS database

3.1 Experiment details

- *reference number for experiment*
- *details of laboratory and institute*
- *short description of experiment*
- *names of experimenters (optional)*
- *references to reports and papers presenting results*
- *dates of experiment*
- *date on which record was created*
- *description of shaker and other equipment used*

3.2 Subject details

for each subject:

- *subject reference*
- *name (optional)*
- *date of birth (optional)*
- *age*
- *gender*
- *weight (kg)*
- *height to temples (cm)*
- *height to shoulder (cm)*
- *height to elbow (cm)*
- *elbow joint width (cm)*
- *hand breadth (cm)*
- *knee joint width (cm)*
- *ankle joint width (cm)*
- *seated height (cm)*
- *hip breadth when seated (cm)*
- *buttocks-knee length (cm)*
- *any additional information (text)*

3.3 Experimental conditions

for each seat:

- *short description (label) of seating condition*
- *photograph*
- *height of seat surface (m)*
- *depth of seat surface (m)*
- *seat angle from horizontal (degrees)*
- *backrest height (m)*
- *backrest angle from horizontal (degrees)*
- *any additional information (text)*

for each posture:

- *short description (label) of postural condition*
- *photograph*
- *ankle angle*
- *knee angle*
- *hip angle*
- *elbow angle*
- *inclination of lumbar spine*
- *inclination of thoracic spine*
- *inclination of cervical spine*
- *any additional information (text)*

for each motion condition:

- *short description (label) of motion condition*
- *axes [x-axis, y-axis, z-axis, roll, pitch, yaw]*
- *r.m.s. magnitudes [seperately for x-axis, y-axis, z-axis, roll, pitch, yaw]*
- *spectral description (e.g. sinusoidal, broad-band)*

- lower frequency
- upper frequency (if not sinusoidal)

3.4 Measurements

for each data channel:

- measurement site
- channel of data file in which data are stored
- measurement axis [choice of x-axis, y-axis, z-axis, roll, pitch, yaw]
- measurement quantity (e.g. displacement, acceleration, force)
- measurement unit
- sampling rate (samples per second)
- high pass cut-off frequency (Hz)
- low pass cut-off frequency (Hz)
- sign convention
- calibration constant to apply (if any)
- transducer description
- details of pre-processing performed on the data (e.g. mass cancelation, correction for skin response)

3.5 Results

For each combination of subject and condition:

- file path for time history data
- channel offset (channel in data file corresponding first data channel for this combination of subject and experimental condition)

4. Data File Format

4.1 Main Header (fixed length)

| | | |
|-----------|---------------|--|
| headlen | (long) | length of the header (bytes) |
| nchnls | (long) | number of channels |
| status | (long) | indicates data precision and if all channels have the same number of points and sampling increment |
| maintitle | (string(512)) | description of the data-set |
| startref | (double) | origin of the time/x-axis (Days and fractions of days since 0:00, 01/01/1900). 0= not applicable. |

4.2 Channel Header (fixed length)

for i = 1:chnls

| | | |
|--------|---------------|--|
| dchnl | (long) | channel number (1...nchnls) |
| dxvar | (long) | flag indicating variable increment data |
| dtype | (long) | type of data in channel (real, complex, etc.) |
| dcols | (long) | number of columns of data |
| dlen | (long) | number of samples (rows) |
| dstart | (long) | start of data (byte offset from end of header block) |
| title | (string(512)) | description of the data in this channel |
| runit | (string(32)) | units of real part (SI conventions – see note) |

```

iunit      (string(32))  units of imaginary/phase part
                        (for real/imag and modulus/phase data)
xunit      (string(32))  units of x-axis scale
orig       (double)      offset of the time/frequency (x-axis) scale
incr       (double)      time/frequency increment
offset     (double)      data offset
scale      (double)      signed scale-factor
lpf        (double)      low-pass frequency if applied (Hz)
hpf        (double)      high-pass frequency (Hz)
stats      (double[6])   reserved for statistical information
end

```

4.3 Data

Data points (chnl(1,1...dlen1), chnl(2,1...dlen2)...etc)

5. Experimental Data To Be Stored In The Common Data Base

5.1 Data supplied by FIOSH

Subjects:

4 subjects with the characteristics given below:

| S-No. | KPM | KPH | Age | FGB | KNB | EBB | HGB | ACH | EBH |
|-------|------|-------|-----|-----|-----|------|-----|-------|-------|
| 131 | 73.2 | 172.1 | 23 | 6.7 | 9.1 | 6.2 | 5.5 | 142.2 | 108.2 |
| 156 | 74.6 | 176.7 | 20 | 6.9 | 8.4 | 6.1 | 5.4 | 146.5 | 109.9 |
| 113 | 74.4 | 175.2 | 21 | 6.6 | 9.0 | 6.50 | 6.1 | 142.4 | 110.7 |
| 224 | 72.8 | 175.6 | 19 | 7.1 | 8.6 | 7.00 | 5.7 | 142.5 | 109.5 |

Table 1. Selected measured anthropometric characteristics of four subjects (S):
 KPM = Body mass in kg, KPH = height to temples in cm, Age (in years)
 FGB = ankle joint width in cm, KNB= knee joint width, in cm EBB = elbow
 joint width in cm, HGB = hand breadth in cm, ACH = height to shoulders in
 cm, EBH = height to elbows in cm, MV = mean value, SD = standard
 deviation.

Exposures:

65 seconds random low-frequency vibration in z-axis, 0.7, 1.0 and 1.4 ms⁻² rms
 weighted (ISO 2631, 1985) acceleration, relaxed posture, hands at a steering wheel

Measures:

- acceleration at the hard seat
- input force
- accelerations in z-axis at the head, shoulder, spinous processes L3 and L4

5.2 Data supplied by NIWL

Subjects:

24 subjects (11 males, 13 females) with the characteristics given in Table 2. The following anthropometric data is available.

- Total body mass (kg)
- Sitting weight (kg)
- Body length (cm)
- Age (years)

Exposures:

20 seconds random low-frequency vibration (2-20 Hz) in z-axis with frequency unweighted acceleration levels of 0.5, 1.0 and 1.5 ms⁻² r.m.s.

Comfortable upright sitting posture with hands resting on the lap. Horizontal thighs with feet positioned on a footrest which did not move with the seat.

Measures:

- acceleration at the hard seat (x-, y- and z-direction)
- input force (x-, y- and z-direction)
- subjective ratings of discomfort.

5.3 Data supplied by ISVR

Subjects:

4 subjects with the following characteristics.

| Subject | Age [yr] | Height [m] | Weight [kg] |
|---------|----------|------------|-------------|
| 1 | 33 | 1.67 | 63 |
| 2 | 32 | 1.81 | 83 |
| 3 | 23 | 1.75 | 73 |
| 4 | 29 | 1.69 | 65 |

Exposures:

60 seconds random low-frequency (0.5 – 20 Hz) vibration in z-axis; 0.5 and 1.0 ms⁻² rms acceleration (unweighted); no backrest; upright comfortable posture; hands in lap; feet unsupported.

Measures:

- z-axis acceleration at the hard seat;
- z-axis input force (with mass cancellation);
- z-axis acceleration at the head;
- z-axis accelerations at spinous processes T1, L1 and L3.

Effect of local tissue-accelerometer system were reduced by assuming that the system can be represented by single degree of freedom system. Effect of the inclination of the accelerometer axes to the basicentric coordinate were reduced by assuming that the displacement response is small. The motions at the centre of vertebra were estimated by assuming that the vertebra is rigid. The size of vertebra is also assumed.