D

BRIDGE WEIGH IN MOTION PROGRAM

The main menu of the B-WIM program displays the following options:

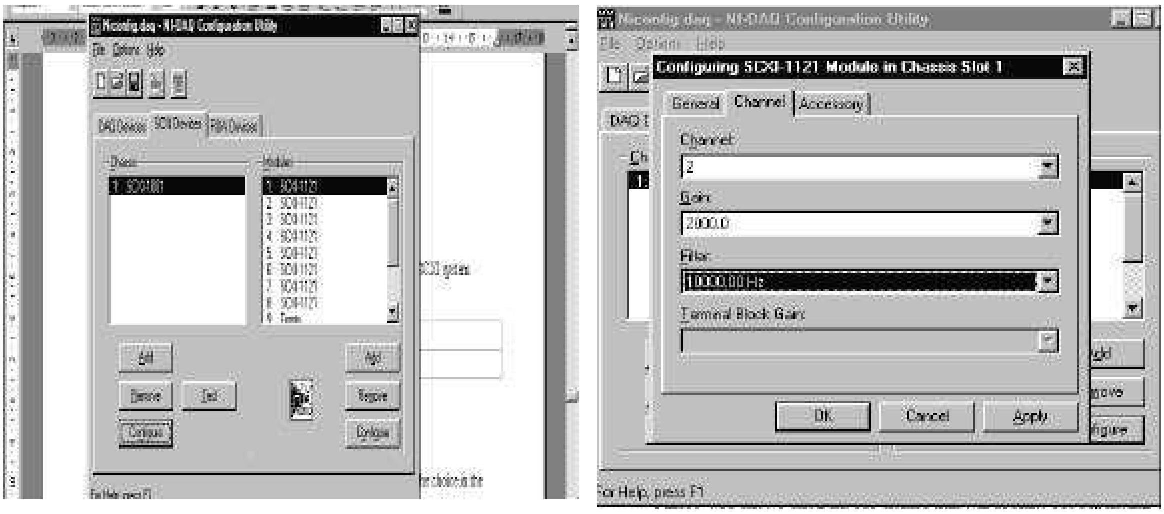
A. Data acquisition
B. Voltage signal
C. Strain & time storage
D. Calibration
E. Calculation of Weights
F. Files
Q. Quit

Option A – Data Acquisition

The following options are presented when option A is selected in the main menu:

A.1) Configure NI-DAQ
A.2) Record Data in Labview Binary format
A.3) Record Data in Text format viewing the signal
A.4) Convert Labview Binary file into Text
A.5) Convert Text into Binary C format
A.6) Compress/Decompress/Delete/See file
A.7) Backup or restore from tape
A.8) Main Menu

The PCMCIA DAQ card includes NI-DAQ driver software[13] for controlling the SCXI system outlined in Appendix C. Option A.1 is a shortcut to this software whose main window is illustrated in Figure D.1(a). The user specifies the DAQ card, cabling assembly, chassis type and the module type to be used in each slot. Figure D.1(b) shows the configuration of a chassis slot for a SCXI-1121 module. Each terminal block, channel gain and filter are initialised. This specification of the hardware component settings is necessary prior to running any DAQ program.



(a) SCXI Configuration (b) SCXI-1121 Module Configuration

Figure D.1 – NI-DAQ Configuration Utility

Options A.2, A.3 and A.4 provide access to the Labview programs for the DAQ, developed by Kealy (1997) and were referred to at the start of this section.

Option A.4 converts the recorded binary Labview file into text (Figure D.2(a)). As part of the heading in the binary file, information on the starting time, date, scanning frequency and number of channels is output in addition to the corresponding voltage for each channel.

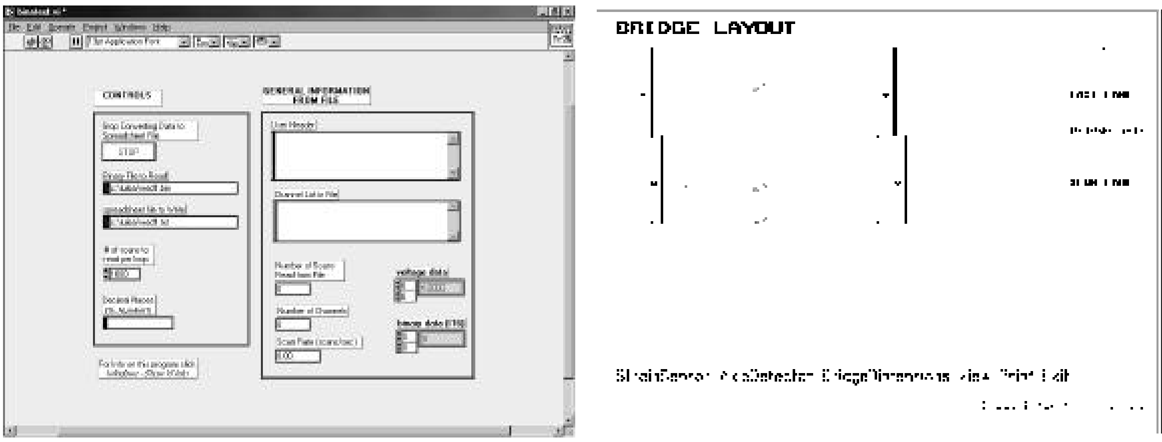
Once the text file is obtained, it will be re-converted into Binary C (Option A.5). The rest of the B-WIM program is written in C as it processes calculations faster than Labview. Binary files are preferred as they take less memory and they do not require a slow sequential search as in the case for a text file. The previous conversion into text was effected because of the difficulty of passing from Labview binary format (written in 12-bit unsigned word) to C (8 and 16-bit) directly. Apart from voltages, the heading of each Binary C file will store data on the starting time and date, and additional information on:

- The site: Location, route and road condition, direction of traffic flow and number of lanes.

- The bridge: Typology, section characteristics, number of spans and longitudinal and transverse dimensions.
- Scanning frequency and filter type.
- The correspondence between channel number, and sensor type (specifying which are axle detectors and which are strain transducers), and exact location of each sensor relative to the first support of the bridge.

Before starting the conversion into Binary C, the program displays the installation layout and allows for the modification of erroneous data through the interface shown in Figure D.2(b).

Options A.6 and A.7 provide access to commercial software for restoring/backing up files to a tape, and compressing, decompressing or deleting them from the hard drive to solve storage problems. After zipping, a binary file can be reduced from its original size by a factor of forty.



(a) Conversion Binary Labview into text (b) Sensor layout

Figure D.2 – Conversion from Binary Labview into Binary C

Option B – Voltage Signal

The sub-menus that will appear when checking the voltage signal are:

B.1) Date, Time and Location characteristics

B.2) Convert text file into Turbo C binary format

B.3) Convert binary file into text

B.4) Analyse voltage signal from axle detectors

B.5) Analyse voltage signal from strain gauges

B.6) Main menu

Option B.1 displays the characteristics of the site for an existing Binary-C file. Option B.2 is identical to A.5. Option B.3 converts an existing Binary C file into text format. This option also allows the conversion of the whole Binary C file or the specification of the starting and ending scan of the segment to be converted.

Option B.4 allows numerical or graphical axle identification. The graphical display of the signal from the road sensors is shown in Figure D.3. This program shows the passing of each axle as a vertical discontinuous line with the scan number corresponding to the axle hit on the screen. The upper part of the screen shows the measured voltage and the lower part the first derivative with time. The different parameters for axle detection (*p,r*) can be adjusted on the screen to ensure that every axle is identified. Other control parameters such as maximum number of axles or maximum feasible number of scans between tubes allow for other anomalies to be detected. These values can vary for different sites depending on the installation and hardware settings.

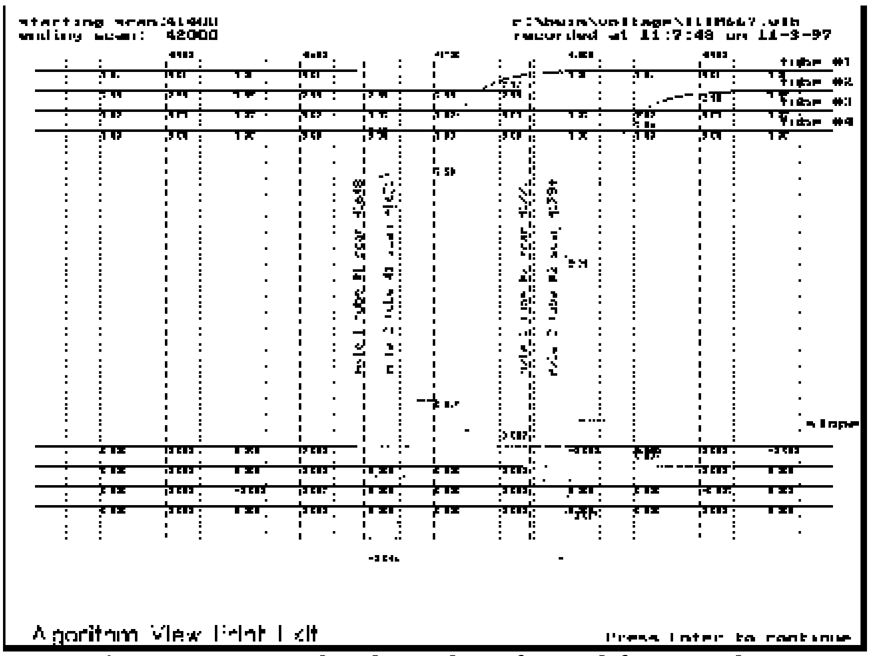


Figure D.3 - Graphical Display of signal from road sensors

Option B.5 visualises the output of each strain transducer. A starting scan number is given for options B.4 and B.5 to search the traffic file. The number of scans to be viewed and the scale can be adjusted in every window.

Option C – Strain and Time Storage

Once the parameters for axle detection have been properly adjusted in Option B, Option C will proceed to store only the scan numbers corresponding to axle hits and strain due to the passing of a vehicle on the bridge. Those intervals of time where there is no traffic on the bridge will not be saved. The objective of this simplification is reducing storage and it speeds up the calculation of weights in a later process. After running this option, the screen shows statistics for each lane on the total number of vehicles of each class and the number of errors due to a missed or extra axle in a tube. If errors are excessive, it will be necessary to re-adjust the axle detection parameters.

Another option in Menu C extracts all information on times from a given vehicle number to another vehicle number. Once the vehicle which is the object of study has been detected in the time file, the corresponding strain record can also be extracted in text.

Option D – Calibration

The calibration menu is as follows:

- D.1) Enter Truck characteristics
- D.2) Enter Bridge characteristics
- D.3) Enter Strain characteristics
- D.4) Obtain Calibration parameters from time file
- D.5) Obtain Calibration factor
- D.6) View calibration adjustment graphically
- D.7) Main menu

Option D.1 enquires about the number of axles, axle spacings and static weights of the calibration truck. Option D.2 enquires about the span length, distance from the tube to the bridge support and distance from the bridge support to the location of the strain transducers.

Option D.3 enquires about the name of the strain file containing the record of the calibration truck, the starting scan of the record (instant in which the first axle hits the first tube), duration in scans, scanning frequency and average velocity.

If Option D.4 is chosen, all the characteristics requested in D.2 and D.3 will be read from the heading of the Binary C file. In this case, number of axles, axle spacings and static weights of the last test vehicle are shown on the screen. If they are not correct, the user can modify them. The search can be initialised to a certain starting scan. Then, the program will start to look for a vehicle with similar characteristics. The user stops the search once the correct vehicle has been identified.

Option D.5 determines the calibration factor based on Section 3.3 and Option D.6 displays the quality of the adjustment as shown in Figure D.4.

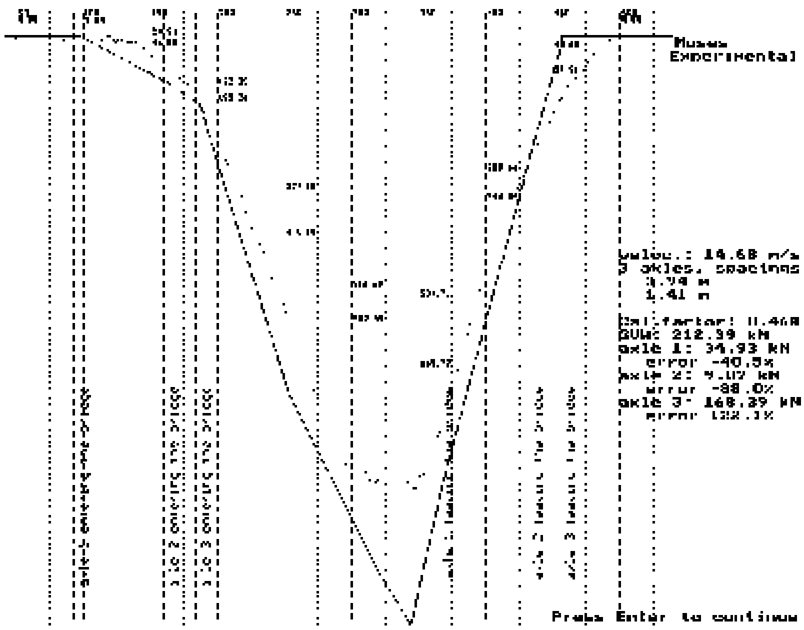


Figure D.4 - Calibration

Option E – Calculation of Weights

Finally, the menu for calculating weights provides the following options:

E.1) Calculate Weights for a particular traffic event

E.2) Calculate Weights for a whole file

E.3) Change calibration factor, recalculating weights

E.4) See weight file

E.5) Main Menu

As the vehicles and times have already been classified in Option C, Option E.1 allows the selecting of a particular vehicle number and obtaining the corresponding weights. Option E.2 will calculate weights for a whole traffic file. Option E.3 allows the changing of the calibration factor and recalculating the whole traffic file. Option E.4 displays the output file on screen. The row of each output file contains information on an individual vehicle. Each column represents a specific characteristic of a traffic event. Table D.1 shows a small portion of this output file for a given voltage input.

Table D.1 - WIM Data Output

DD	MM	YY	HH	mm	ss	hh	event	L	HEAD	GAP	SPD	Length	AX	WBTOT	W1-2	W2-3	W3-4	GVW(kN)	AW(kN)-1	AW(k
12	7	97	2	27	41	30	9	0	3549	3532	25.37	4.54	2	2.54	2.54	0	0	7.72	1.3	
12	7	97	2	28	16	79	10	0	17141	17124	25.09	4.46	2	2.46	2.46	0	0	11.19	2.49	
12	7	97	2	31	8	20	11	0	19915	19898	25.54	4.5	2	2.5	2.5	0	0	9.98	1.41	
12	7	97	2	34	27	36	13	0	175	157	24.18	4.42	2	2.42	2.42	0	0	7.83	1.35	
12	7	97	2	34	29	11	14	0	27154	27137	26.61	4.61	2	2.61	2.61	0	0	10.8	2.61	
12	7	97	2	36	13	43	6	1	36377	36360	27.57	4.7	2	2.7	2.7	0	0	12.43	1.02	
12	7	97	2	39	0	65	15	0	1194	1179	27.91	4.29	2	2.29	2.29	0	0	9.18	3.36	
12	7	97	2	39	12	60	16	0	7533	7517	27.18	4.39	2	2.39	2.39	0	0	7.4	2.08	
12	7	97	2	40	27	93	17	0	18874	18855	23.68	4.65	2	2.65	2.65	0	0	12.23	2.47	
12	7	97	2	42	17	20	7	1	7945	7933	38.8	4.79	2	2.79	2.79	0	0	11.28	1.64	
12	7	97	2	43	36	65	8	1	31811	31765	25.18	11.67	4	9.67	3.12	5.14	1.41	109	6.25	
12	7	97	2	43	36	67	18	0	9244	9200	29.34	13.03	4	11.03	3.52	5.87	1.64	120.82	24.09	
12	7	97	2	45	9	11	19	0	7827	7814	35.56	4.63	2	2.63	2.63	0	0	5.03	1.46	
12	7	97	2	46	27	39	20	0	354	339	28.47	4.45	2	2.45	2.45	0	0	8.19	2.4	

The meaning of the columns in Table D.1 are as follows:

- *DD*: Day, *MM*: Month, *YY*: Year, indicating the date that this traffic event took place.
- *HH*: Hour, *mm*: Minute, *ss*: Second, *hh*: Hundredths of a Second, indicating the arrival time of the vehicle onto the bridge.
- *Event*: Number of vehicle arriving into that lane for that file.
- *L*: Identification number for the lane where the vehicle is travelling (0: Slow; 1: Fast).
- *HEAD*: Time (hundredths of a second) between the first axle of two consecutive vehicles.

- *GAP*: Time (hundredths of a second) between the rear and the front of two consecutive vehicles.
- *SPD*: Speed in m/s.
- *Length*: Vehicle length calculated as total wheelbase plus 2 m.
- *AX*: Number of axles.
- *WBTOT*: Total wheelbase calculated as spacing between first and last axle.
- *W1-2*: Spacing between 1^{st} and 2^{nd} axle in m, *W2-3*: Spacing between 2^{nd} and 3^{rd} axle in m, and so on.
- *GVW(kN)*: Gross Vehicle Weight in kN.
- *AW(kN)-1*: Weight of 1^{st} axle in kN, *AW(kN)-2*: Weight of 2^{nd} axle in kN, and so on.

The source code and executable files of the program are included in the CD-ROM (Appendix H). Further details on the files, structures and data types of the program are given in a word document in the disc.