Bay Systems

Bay Bug Box (BBB) (Insect Stimulation & Recording System)

Introduction

Insects are studied for many reasons including optimisation of their role in plant pollination e.g. Bees and in pest control e.g. Chrysoperla (Lacewing); In particular an understanding of their methods of communication is important if we wish to understand and eventually influence their behaviour.

The BBB enables researchers study the low frequency vibrations that some insects use. The BBB will stimulate a specimen insect using a recorded vibration or sound and then allow the researcher to record the insects response.

The system comprises: -
Personal Computer (Windows based)

Control system
> Vibration sensing probe
> High gain low noise pre-amplifier
> Power amplifier

Loudspeaker/shaker + insect chamber

Software system
> to control excitation and recording
> To analyse the signals from the insect

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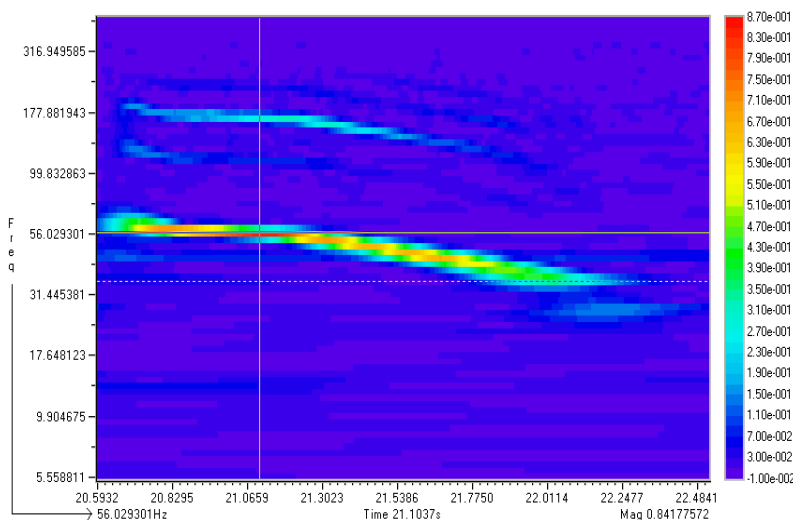**Crysnal House Main Road, Westhay, Glastonbury, Somerset UK. BA6 9TN**

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Time History recording of the Chrysoperla (Lacewing); this particular example was recorded by our customer in India within a few days of receiving their first BBB
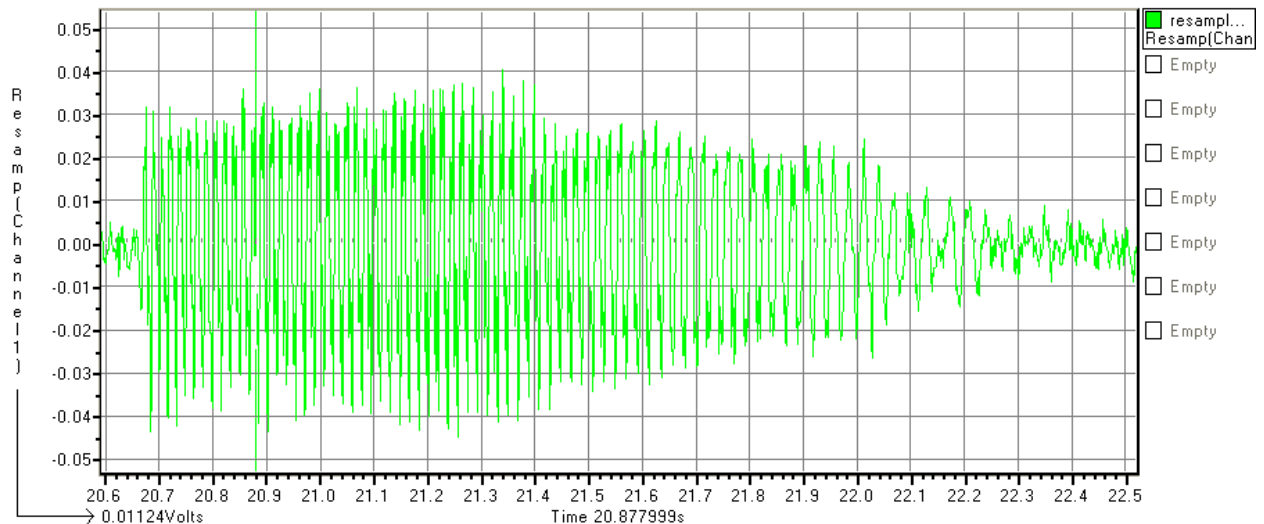
The frequency of these signals is extremely low; typically between 30 – 125Hz. The amplitude is also very low as the insect is small it has limited capability to generate noise and or vibrations at these low frequencies. The "sound" when played through a loudspeaker will only be audible when amplified by 100+ times i.e. 40dB.

The sound when the Lacewing is on a leaf or in a laboratory "studio" will be inaudible.

The wavelet analysis is particularly well suited to the analysis of the lacewing "songs" the ability to capture both the instantaneous frequency and its amplitude allows the underlying modulations to be easily identified.

The time axis is horizontal i.e. the X axis.

The Frequency axis is the Y axis and the intensity or level of the vibration/sound is the degree of colour; blue is low and red is high level.

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Unpacking the BBB

The system is packed for shipping inside a double cardboard box using air bags and polystyrene to absorb shipping impacts. Nevertheless a determined shipper will be able to damage the system and so it is necessary to inspect the outside of the box and the product carefully. Any obvious damage to the packaging should be pointed out to the shipper and a digital photograph taken to support the claim.

The most likely damage is to the bearings and structure of the Tone Arm that supports the pickup. This pickup is a high quality HiFi Tone Arm but does not need to track a record's grooves accurately or move very smoothly. It is necessary only for it to support the cartridge and to be able to be positioned reliably. Some adjustment and reassembly of the bearings etc will be possible using a screw driver and a set of small Allen Keys (not supplied). You are of course entitled to a perfect product and any damage will be made good should you choose to return it.

Assembly of the component parts

The control module contains all the electronics and connectors and provides the base for the tone arm. The Tone arm is mounted securely to the control module. Two additional components need to be added to the tone arm to complete it : -

1. The counterweight, see the photograph be low, needs to be screwed gently onto the end of the Arm. The semi-captive plastic key held in by an Allen set screw will engage and track up arm, go up to the green insulating tape. This is the 2g playing weight needed/ recom mended for the Sure cartridge. Please care fully remove the green tape once the weight is positioned; the dial on the front surface of the dial should be carefully set to show 2.0. This will then allow you to accurately increase or decrease the force on the stylus. Do not exceed 5g as this is the practical limit for the cantilevered stylus support.

2. The Stylus, packed in its own box, needs to be carefully slid into the cartridge. This is done done holding the Tone Arm and cartridge gen- tly but firmly with one hand while carefully offering up the stylus with the other hand. Carefully align the stylus shaft with the hole in the cartridge. The stylus is then pressed into the cartridge smoothly until it is fully seated, all the parts will be flush when properly seated.

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3.   Installing the software on your chosen PC: First locate the two CDs; one is the Data Translation CD that contains the driver files that allow the nVision software to control the ADC. The other is the nVision CD together with the instruction manual for nVision, these can always be downloaded from the Bay Systems' web site.

Load the DT CD into the computers drive and follow the on screen instructions, you need to get to the point where you load the DRIVERS. If you are given choices then select the OEM and the Windows 32 options. Normally the CD will install the drivers without problem, please ask the help of your IT department if you are unsure of what to do or you PC is secured against software installation. When the DT CD has completed installation please place the nVision CD in the drive and again follow the onscreen instructions, installing the basic nVision 32 system. You will see   amongst the other components a small USB security key, this is used to secure the software and allow it to run on any PC. To enable this USB key to work you must install the key driver. This is found under the other software option on the nVision CD.

Be sure that the key is not plugged in while you install the driver. If it is plugged into the PC you will destroy the USB security key and need to purchase another one and suffer the consequent delay.

4.   <u>Plugging together the other components.</u> Assemble, on your bench, the computer you will use and ensure that you have access to the sound card output sockets and a USB port.

Fit the correct mains electricity plug to the BBB power chord supplied, it is shipped with the current UK three pin plug which is fitted over a standard European two pin plug. The other end of the mains cable, after the transformer, terminates in a SPEAKON power plug that will connect to the BBB.

The loudspeaker is connected to the system using the SPEAKON terminated cable, the two spade connectors are pushed onto the loudspeaker spade tags. The SPEAKON connector will only fit into the correct socket on the control module.

The USB cable, with twin Type A, connects the computer to the BBB's ADC system.

The Sound card output from the computer is connected to the BBB using the supplied 4mm jack and the Phono to BNC connectors.

Obtain a light container/cup that will fit snugly onto the cone of the loudspeaker, the Container can be secured using a BlueTack gasket. Alternatively an old CD can be attached to the cone, again using BlueTack and a light cup stood on the CD again using BlueTack to prevent it moving. The use of a CD as a shaker Table may introduce unwanted resonances so please experiment to find the best solution.

Cover the top of the container/cup with plastic film secured loosely with tape; be sure that the film is not stretched to form a drum skin as this will create resonances. If possible pierce the film to ensure that the enclosed air does not also form a resonator.
Position the speaker and cup assembly in front of the BBB, so that the Tone Arm can be placed on the film surface.
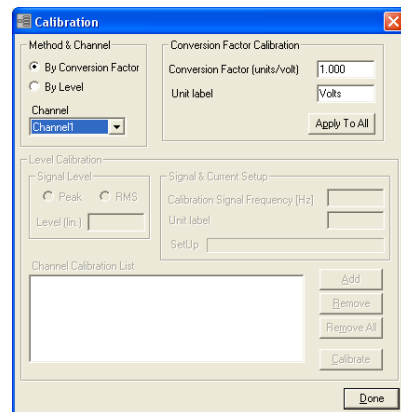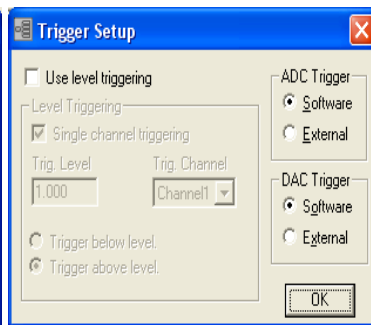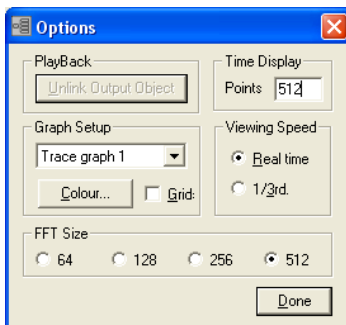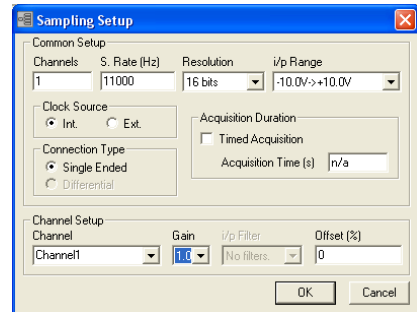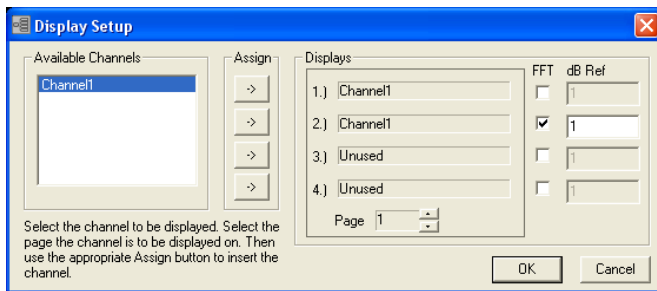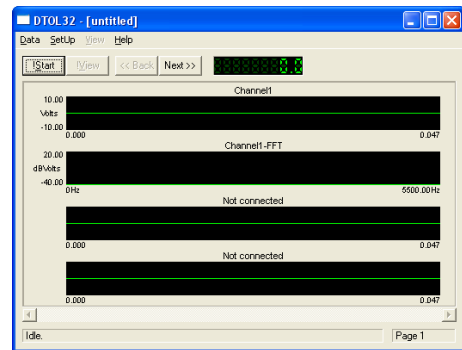
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5.   The system should now be fully connected i.e.
        Computer sound card to BBB
        BBB loudspeaker output to speaker
        Tone Arm resting on film over container
        BBB ADC USB cable to PC.

6.   Provided that you have read the nVision manual you are ready to start the system.

7.   Lift the Tine Arm off the Film and place it on the rest — this will prevent damage to the sytus
        when the power to the loudspeaker is switched on.

8.   Switch on the BBB by plugging the power in. The computer will now detect the DT ADC sys-
        tem and will load the driver.

9.   Start the nVision software and click on the DRIVERS tool BAR. Double click the DTOL driver
        and follow any instructions, these may include typing a control line into a Windows system
        file. The DTOL control panel should now appear and allow you to set up the data acquisition
        parameters. The parameters you should initially try are: -

        Select the ADC card Type   = 9816
        Sample rate   = 11000 Hz
        Number of channels   = 1
        Set the calibration   = 1
        Time display points   =512
        FFT size   =512
        Displays
        map channel 1 to display   = 1
        Mao channel 1 to FFt display   = 2
        Trigger choose software

        Please check that all screens look like these:

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10.   Taking Data.
The ADC card has a 2x gain which you should probably choose as the input to the ADC is unlikely to be more than 5volts.

The ADC system only shows the data on the screen when it is running. The data is throughput to a temporary file which is overwritten when the start button is pressed again. It is therefore vital to create the data file from this temporary file as soon as it is created.

The left hand red rotary knob marked pickup gain allow you to set the voltage applied to the ADC; turn this fully clockwise for maximum gain. It is likely that the vibrations generated by the insect will be low and the maximum gain will be needed.


The right hand rotary knob is the output level control for the power amplifier that is driving the loud speaker. If you are resting the pickup on the film over the cup then set this control fully anti-clockwise, the minimum. You should use the computer sound card control to set the output level of the sound card to approximately 3/4 of maximum, this should avoid any distortion inherent with cheap sound cards when driven at maximum level.

The file that you are going to use to drive the loudspeaker can be one that you have recorded or one that you have downloaded from the web or obtained elsewhere. The output can be controlled from the TRACE display of nVision if you wish but only type 1 wav files can be read into nVision. If the wav file is type 2 then play it using the Media player or any other program that works.

The Comanche wav file is a Type 1 wav but all others from the Charles S Henry web site are type 2.

The TRACE display and dialogue box shown on page 7 show the Comanche signal in the TRACE Display and the set up of the output that is accessed from the Options pull down menu. Alternatively the DSP toll bar contains a signal generator that may be used to produce signals. To test the capabilities of the Tone Arm and the ADC system a series of pure sin waves can be generated and output to the loud speaker. When play is clicked the portion of the waveform between the solid and dotted cursor will be played at full volume and will repeat indefinitely. To ensure that an impulse is not sent to the speaker the solid and dotted cursor positions should be chosen to be at 0 volts and with the a contiguous slope. Once the output is started the stylus can be positioned on the film and the gain increased a little.
The DTOL drive can now be started and the wave form observed.
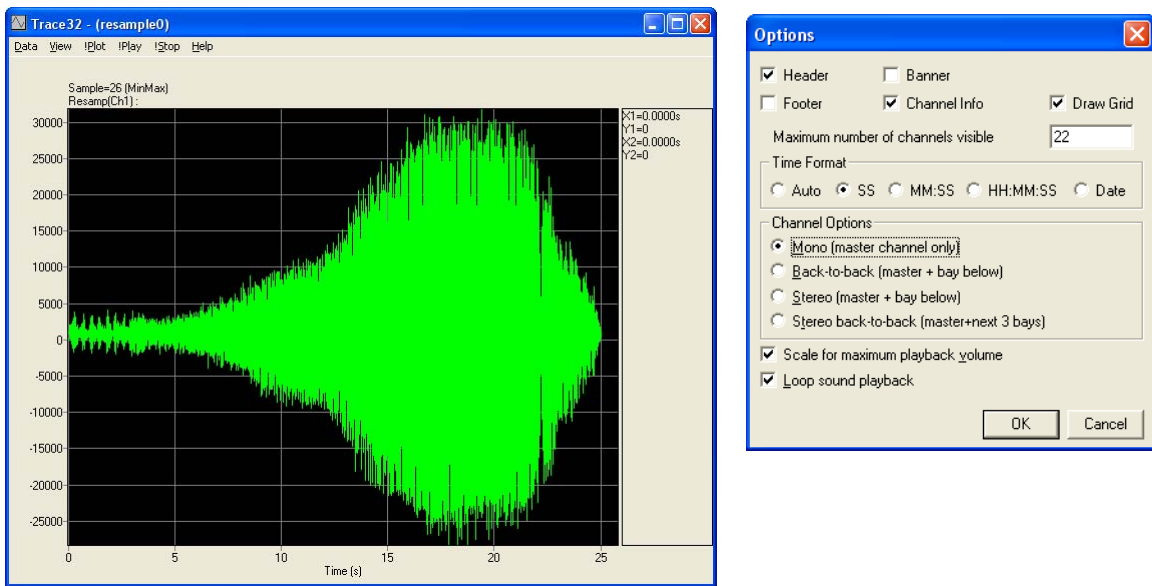
The speaker can be excited with a "real" insect vibration, as shown above, or with a series of sin waves, shown below, the sine waves have been sensed using the Tone Arm and Stylus and are displayed below at 100, 200 and 400 Hz. In this recording the stylus was positioned on a CD the relatively poor result at 200Hz was Probably due to a resonance in the CD. The very good representation of the waveform at 100 Hz indicates that the system will make a very good job of gathering the 30 — 125Hz vibrations generated by the Lacewing
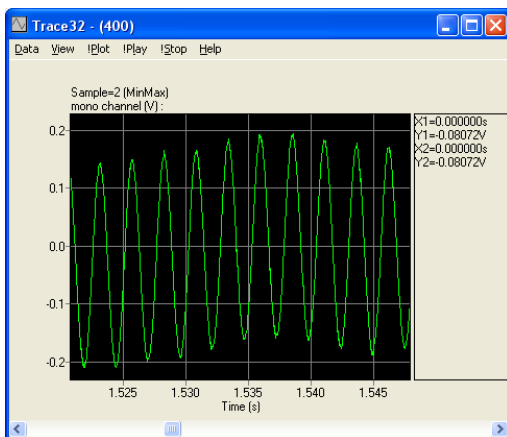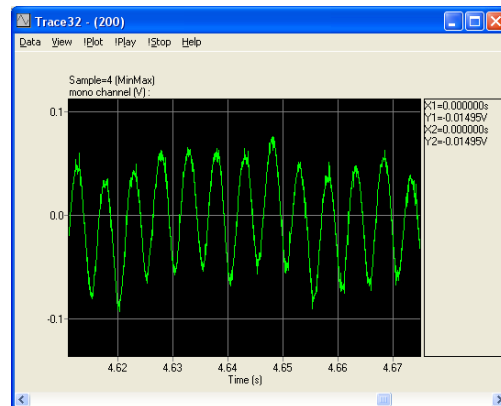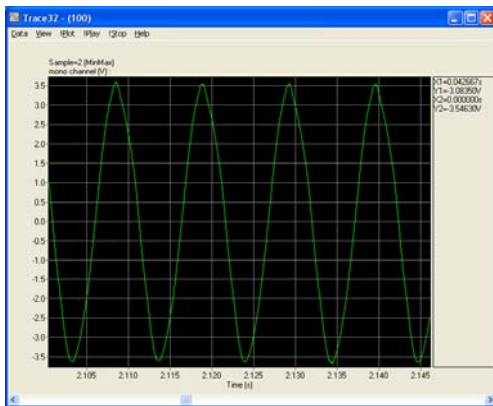
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11.   Some do's and don'ts : -

A) Be very careful when positioning and using the stylus, keep it on the stand and secured to ensure you do not knock the arm and send the delicate cartridge and stylus crashing into the loudspeaker.

B) Never turn the BBB on or off with the stylus on the loudspeaker.

C) Always create a signal object at the end of any DTOL recording if the data looked good.

D) Order at least two replacement Stylus' as you will certainly break one!

E) Do not turn the gain up too high on the loudspeaker you are not supposed to be able to hear the signals.

F) HUM. Mains electricity is supplied at 50 or 60Hz depending on the country you are in. We are recording at precisely these frequencies and so the cross coupling of mains frequency into our recording system will reduce the fidelity of our recordings. When the BBB is manufactured it is carefully checked for cross coupling (mains hum) and all earthing points carefully inspected to ensure that hum is at a minimum. The sound card in a PC is likely to produce mains hum it is advisable to buy a good quality stand alone sound card that is housed outside the PC and is connected to the PC by USB. The setting up of this device may be difficult as the built in sound card will be configured already in the PCs system. The help of your IT department should be sought if configurations problems arise.

G) Do not leave the BBB permanently plugged in; the power and pre-amplifiers will be on.

H) Build a user tool bar so that all the analysis modules that you want are on a single tool bar.

I) Read the nVision manual and watch the tuition examples.

J) A support contract can be taken out that will give you access to online help; this will provide a quick start for complex analysis tasks. Using Skype as and a computer microphone and headset reduces the cost of telephone to nothing.

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