Physiologically-based feedback control for neuroethological experiments using synthetic environments

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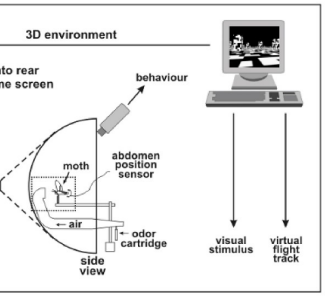
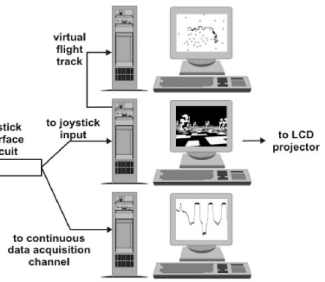
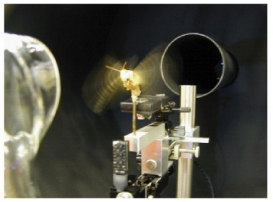
motion requires integration of salient sensory cues with ongoing motor activity. obile, preparations produce confounding feedback artifacts, experiments with asily lead to an insurmountable number of variables due to variability between within the real world. Access to integrative centres within the central nervous obtained by using immobile preparations presented with appropriate sensory thod that utilizes depressor asymmetry observed in forewing first basalar (m97) ve visual stimulation of a motion sensitive pathway. Consistent wing phase shifts etries have been observed during adaptive flight maneuvers, making this a useful aviourally appropriate visual feedback. The method uses rigidly tethered locusts wings and converts differences in bilateral m97 spike times to analog voltage s can be used to control open-loop (insect movement in a virtual environment interface), and closed-loop experiments (insectm movement in the virtual ed by the insect itself). Electromyographic (EMG) signals were obtained from right time difference between them was calculated and converted to voltage values. l animals, we observed that we were able to detect the spike time difference and controlled the presentation of a stimulus in a closed loop environment.

Experimental setup







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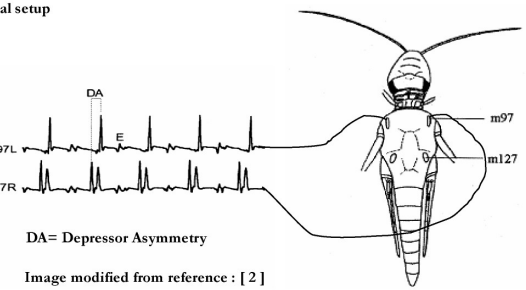

DA= Depressor Asymmetry

Image modified from reference : [2]

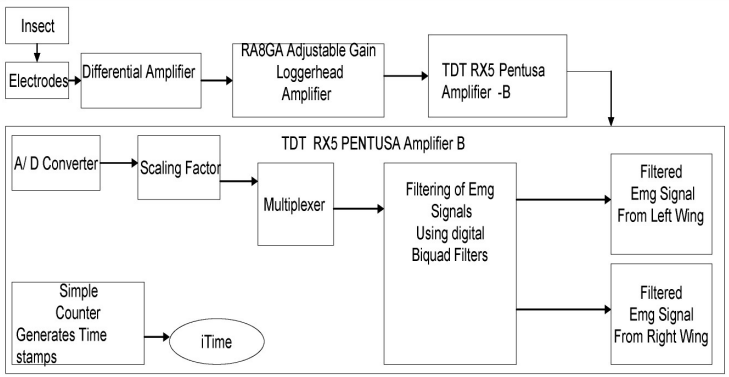

Fig. 2 Schematic diagram of data acquistion system

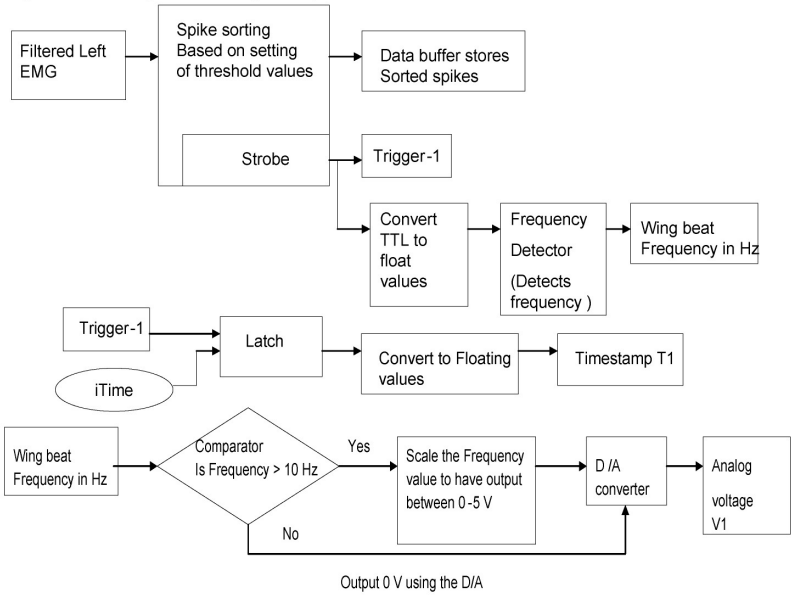

Fig. 3a Spike sorting of EMGs from left wing and generation of times stamps.

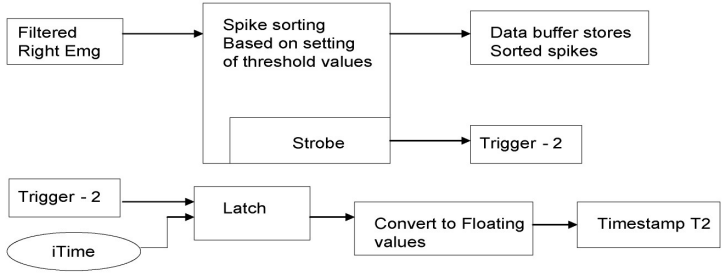

Fig. 3b Spike sorting of EMGs from right wing and generation of times stamps.

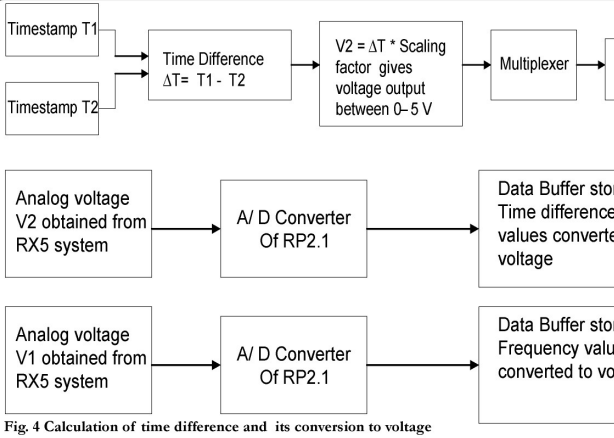

Fig. 4 Calculation of time difference and its conversion to voltage

RESULTS

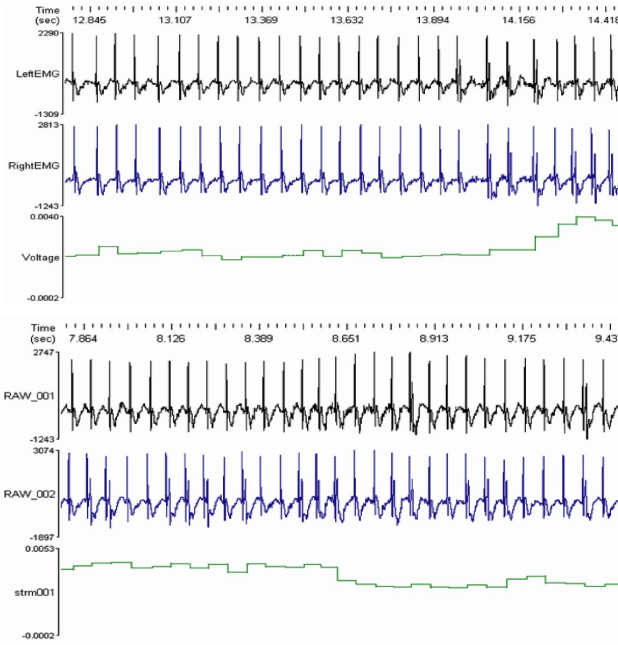

Fig.5 (top trace) right forewing depressor muscles advanced in timing when stimulus was pr
(bottom trace) left forewing depressor muscles advanced in timing when stimulus was r
loop experiment.

CONCLUSION / SUMMARY

- Tethered insect was able to determine the position of its body in the yaw plane acc
the timing of spikes of depressor motor neurons to the left and right wings.
- Depressor asymmetries converted into voltage values that can be used to perform ex
closed loop environment.
- Time difference and voltage relationship can be thought of as a linear relationship i

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[1] J. R. Gray, V. Pawlowski, and M. A. Willis, "A method for recordingbehavior and multineuronal CNS in virtual space" J Neurosci. Methods, vol. 120, Iss: 2, pp. 211–223,October 2002.
[2] K .L. Shoemaker, R.M. Robertson, "Flight motor patterns of locusts responding to thermal stimuli", pp. 477-488, October 1998.
[3] Tucker Davis Technologies, (online support help file) Available:http://www.tdt.com/Sys3WebHelp/