Non-invasive monitoring of honey-bee hive activity using Principal Component Analysis.

Martin Bencsika, Joseph Bencsik, Mathias Millet, Michael Baxtera

aPhysics and Mathematical Sciences, School of Science and Technology, Nottingham Trent University, Clifton Lane, Nottingham NG11 8NS, UK.

Since Karl von Frisch's major discoveries[1] a lot of research has focused on investigating the mechanical vibrations resulting from honey bee activities[2, 3]. In this work we have logged the time course of the global vibration coming from a bee hive and have separated the superimposed independent vibrations.
We are presently trying to demonstrate that our method provides the user with an instantaneous biometric 'signature' of the honey bee hive.

Method: A vibration sensor was secured in the wall of two separate hives, and the output was digitised with a computer.
A MATLAB® code was developed to calculate and store the averaged frequency spectra of the vibration data. These were then analysed using Principal Component Analysis (PCA). Any instantaneous spectrum can then be expressed as a linear combination of 'eigenspectra', the weighting factors of which provides the instantaneous signature of the hive.

Results: In this preliminary work only thirty hours of continuous recording was analysed. Spectra must be averaged for at least six minutes to provide a stable analysis. Five to six meaningful eigenspectra only are needed. Spectral bandwidth of 2000 Hz is enough.

Conclusions and future work: Using PCA, a new non-invasive way of monitoring honey-bee hive activity is demonstrated, that extracts a simple signature. A lengthy recording was launched in late October 2008, and is still being logged by the computer. We will show the results of our PCA analysis applied to this recording, which will hopefully include one or two swarming processes. Our work might have a fundamental beneficial impact on the monitoring and understanding of honey bee health and activit