



Honey bee sound power: estimation of expected sound levels in apicultural audio monitoring

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Honey bee sound monitoring is a rapidly expanding field bordering on acoustics, electronics, and animal husbandry. Within the field, many experiments are performed with microphones being placed both on the beehives themselves and on frames inside. Although showing promising results, these works do not explore the fundamental aspect of sound power levels received during measurements, as they are most often conducted using low-cost metrological equipment with no calibration capabilities. This work focuses on providing a method for determining the expected sound pressure level at any given point where measurements around the bee colony may be performed. Measurements of honey bee sound power levels were conducted with multiple worker bees and drones collected in multiple colonies and geographic locations. The results have shown that drones produce significantly higher summary sound power levels than worker bees when attempting flight, as well as produce predominantly lower frequency sounds, with a focus around the 200 Hz 1/3 octave band. In situ measurements and FEM analysis of beehives was also performed. A software method capable of modelling tens of thousands of individual bees was proposed for the estimation of sound power levels of swarming bee colonies as well as the sound power levels produced by bee colonies in normal states. The results of this work have shown that in the centre of the swarming colony, sound pressure levels reach around 52 dB, while with increasing distance after passing the swarm boundary, the levels decrease rapidly