Airborne Insects Radar Scattering Characteristics Utilizing Electromagnetic Modeling

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A computational electromagnetic method of moments (MoM) implemented in FEKO software, has been utilized to predict the radar scattering characteristics of an aerial insect, a Honeybee worker (i.e. Apis Mellifera), and investigate its dependence of the radar cross section (RCS) at different frequencies, multiple polarizations, and viewing angles. The numerical technique can generate a plethora of radio scattering data through a broad set of azimuth or elevation angles, while attempting to eliminate the practical difficulties that come hand in hand with laboratory measurements. To validate the calculation of backscattering cross sections results of the honeybee model obtained through the FEKO method of moments, we compared the model results with laboratory measurements. These measurements of backscattering cross section of honeybee were performed in the antenna anechoic chamber at the ElectroScience Laboratory (ESL) at The Ohio State University (OSU).

The backscattering RCS measurements of the honeybee were carried out for both horizontal and vertical polarizations over the frequency range between 2 and 18 GHz with a frequency step of 6 MHz. These measurements were performed at the incident angle of the plane wave $\theta = 90^{\circ}$ and $0^{\circ} \leq \varphi \leq 360^{\circ}$. The azimuth angle was incremented by 5°. In general, the simulated backscattering cross section of the honeybee shows a very good agreement with the obtained backscattering RCS measurements. As a result, such modeling techniques can be applied for many insect species and birds and will help to disseminate targets of different shapes and sizes and therefore differentiate between different insect targets.