## ❖ DIGITAL AGRICULTURE, ENGINEERING AND ENVIRONMENT

### Artificial neural networks as a tool for monitoring woolly aphid in apple orchards

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**Abstract**
Apple is one of the most important fruit crops in the world. It is a host for numerous insect pests. One of the most economically important and widespread apple pests is the woolly aphid (Eriosoma lanigerum) (Hemiptera: Aphididae). It develops 10-15 generations per year and causes damage by feeding on roots, developed branches and young shoots, especially in mechanically damaged areas, where it favors the development of secondary diseases and pests. Its feeding weakens mature apple trees, resulting in loss of vitality and quantitative and qualitative yield losses. Chemical control measures are used when 5-8% of shoots are infested; in young orchards, the threshold may be lower. Before deciding to use chemical control measures, a visual inspection of the orchard is required to determine the extent of infestation, which is difficult and time-consuming, especially in large areas. This time-consuming monitoring can lead to late and ineffective chemical treatments. Recently, artificial neural networks (ANNs) have been used as a tool to develop automated monitoring techniques for many agricultural pests and phenomena. By using these techniques, users can respond in a timely manner and provide targeted and effective pest control with less human intervention. Therefore, the objective of this work was to develop an analytical model for the detection of woolly aphid in apple orchards using ANN. Photos of apple trees were collected from March to September 2022. The photos were taken manually from a distance of 50 cm with an RGB camera in five apple orchards in Zagreb County, Croatia. The images were annotated, and the target objects (woolly aphids and other objects) were labeled with bounding boxes and used for training ANN. Finally, there were 2750 labeled objects of the class ''woollyaphid''. The model was developed and showed high accuracy in detecting wooly aphids on test images and great potential for work in practice. This model will be further improved by using larger datasets. The contribution of this work is development of accurate techniques for monitoring important apple pests to enable economically and environmentally sustainable apple production.