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A Novel Drone-based Application to Monitor and Determine Air and Soil Temperature Distributions in Indoor Farming Environments

ARNAB SIRCAR[1], Unionville High School — Indoor farms require frequent monitoring of environmental parameters. This is done manually today and is infrequent and error-prone. Drone-based monitoring can be employed to substantially increase productivity. Various sensors can be mounted on drones, and their flight paths can be programmed to automate the process, allowing direct measurements of parameters. This idea was explored for a mushroom farm. Mushrooms require uniform temperature distributions of ambient air and soil. With drone-based monitoring, temperature measurements can be frequent rather than employing a single thermometer for each large room, giving poor estimates of the temperature distribution. A drone was flown, and air temperatures were collected at designated points. Computational kriging was used to impute missing values and obtain near-continuous distributions that showed a 0.41% error upon validation. Using the air temperatures, a convective-diffusive heat flow model provided soil temperature estimates at boundaries of soil beds. These were then used in a Laplace heat conduction equation to obtain soil temperature distributions. Upon validation, a 1.02% error was observed. Results show that drone-based monitoring can be deployed in indoor farms to increase efficiency and reduce operation costs.

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