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Multipath Interference Investigation for Cotton Bale Microwave Moisture Sensing

Authors: Mathew G. Pelletier
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Since more cotton gins are installing cotton moisture restoration systems, it is becoming increasingly important to accurately determine the moisture content of cotton bales. Recent research at the USDA has shown that bales with too high of a moisture content will undergo a grade change when in storage for as little as 6 months. In order to address these issues, research has been undertaken to develop a microwave based cotton bale moisture sensor. To further this research, the effects of multipath interference on this type of measurement was explored. A finite-difference time-domain model (FDTD) was prepared to aid in the development of a microwave moisture sensor. The prediction of cotton bale, microwaves, antennas, and structure interactions were investigated using this model. The model was shown to have a good correlation to the closed form solution of Maxwell's equations for free-space microwave propagation. When used to determine the effects of a surrounding metal structure typical of a cotton gin, the model indicated that multipath reflections severely affect the transmitted signal. It also indicated that this affect could be calibrated out of the system to yield an accurate prediction of the moisture content of cotton bales within a metal-clad structure.