

Electromagnetic Imaging of Grain Storage Bins: Study of Various Targets and Moisture Contents

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Harvested grain is almost always stored for a significant period of time (sometimes years) before its final use. During its storage, the quantity and quality of the grain often degrades. To keep grain safe during storage, the moisture content and temperature of the grain must be brought to low levels and kept at these low levels during the entire storage period. It has been common practice in the grain industry for decades to monitor grain properties through electrical means as the complex permittivity (dielectric constant and conductivity) is related to the moisture content and temperature of the grain, e.g. (Nelson and Trabelsi, Measurement Science and Technology, vol. 17, 2006).

In (Asefi, *et. al.* Computers and Electronics in Agriculture, vol. 119, 2015), we introduced the concept of imaging the entire bin contents through 3D electromagnetic imaging. In this presentation, we will overview an industrial installation of an Electromagnetic imaging system in an 80 tonne storage bin that operates with 24 antennas inside the bin at operating frequency of 93 MHz. The full vectorial 3D imaging code uses a Finite Element Method based implementation of the Contrast Source Inversion Algorithm. We will present several new results, including the detection of high-moisture, high-temperature regions (known as hot spots), the detection of multiple simultaneous hot spots, the monitoring of a growing hot spot over 10 days, as well as detection of spoiled grain regions of varying moisture contents. In Fig. 1, we show reconstructed image of the real part of the permittivity, generated from experimental data that consisted of a single region of spoiled wheat at 25% moisture content, located in a 55 tonnes of 15% moisture content wheat.

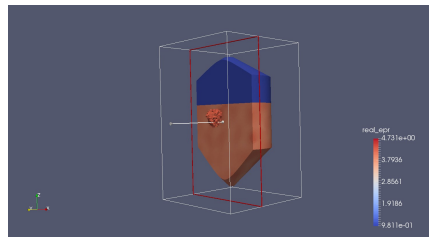


Figure 1: Reconstructed $Re\{\epsilon\}$ of Stored Wheat. Detection of 25% moisture content hot spot in a background of 15% stored hard-red winter wheat.