

# Material Inspection

## by Combining Methods

Wooden utility poles are used throughout the world to carry cables and equipment. But wood is an organic material and it degrades over time; this degradation causes the poles to break. This might happen while someone is doing maintenance on the carried equipment and it will harm the involved people and cause denial of service.

Do not be surprised the next time you see a tree-stump and observe that it looks similar to this one:



The centre of this stump has a different colour than the peripheral and this is a typical sign of decay. There are even missing pieces in centre that indicates the brittle state of the wood.

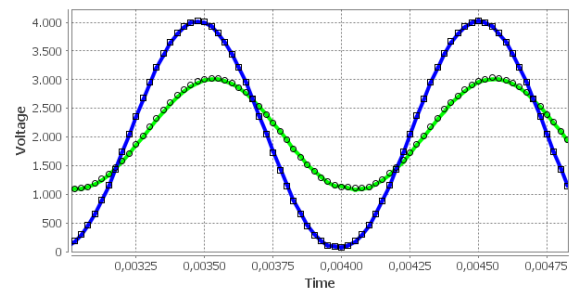
Replacing a wooden pole is expensive and just moving one cost between 2 000 and 200 000 USD in the USA. This is a strong motivational factor for changing them as seldom as possible.

Each pole has a unique lifespan and it is unfortunately very hard to estimate how decayed a pole is. This forces us to try to measure the decay. There are two common methods for doing these measurements. The first method is to drill into the wood and to measure the resistance to the drilling. The second approach is to measure the electric resistance.

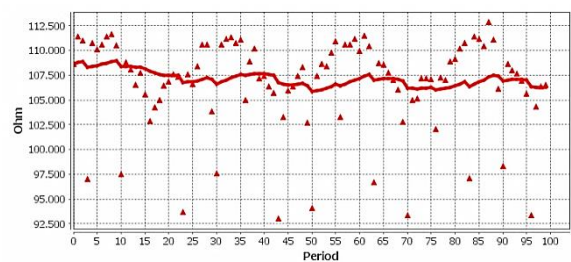
The goal of this project is to develop an electrical measurement system that can be merged to an existing mechanical system. The expectation is that it will improve the accuracy and help prevent that workers fall to the ground on a regular basis.

The project uses an ARM based microcontroller to do all measurements and calculations. The microcontroller simultaneously sends the data to a Java application that plots it. The java application is also used to control the embedded system.

Plotting the voltage vs. time might look like the following figure from the purpose-built java application. The large magnitude signal is the reference signal and the smaller signal has been exposed to the influence of the wood.



Measuring a hundred periods and calculating the resistance for each one might provide the following graph in the same application.



The last figure shows the resistance for each period as a small triangle and the solid line represents the resistance with respect to all the previous values.

The functionality of the system has been verified through an electrical model consisting of resistors and capacitors and it works well within the expected range.