Building an automatic point dendrometer

The most frequently used electromechanical linear position and displacement sensors for small distances make use of resistive, capacitive, inductive, magnetic, time-of-flight and pulse encoding transducers.
Among all, resistive sensors perhaps are the simplest and the cheapest, and hence widely employed as automatic band or point dendrometers. They consist of a linear potentiometer which slider movement generates changes in electric resistance. Hooking the potentiometer to a DC voltage excitation it produces a proportional voltage output that can be converted into millimetres by means an appropriate calibration coefficient.
Although the electric transduction is made by the contact of wipers on a resistive element, they generally have good accuracy and linearity, fair resolution, dynamic response, temperature coefficient and life and long-term reliability, but large hysteresis and poor resistance to shock and vibration.
Potentiometers can have a declared temperature coefficient of several hundred ppm $°C^{-1}$ but used as voltage divider (fig. 1) this parameter is actually much lower and its effect is negligible.
Building a point dendrometer is quite easy just mounting a linear displacement sensor (i.e. Bourns) on an aluminium L-shaped support that is fixed at the trunk by a screw and a bolt (fig. 2). Furthermore, between the slider tip and the transducer housing, a spring must be mounted. In this way, the shaft will be held in place against the bark.

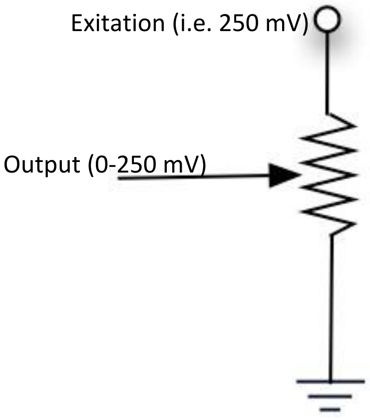

Fig. 1 – Wiring of sensor as voltage divider

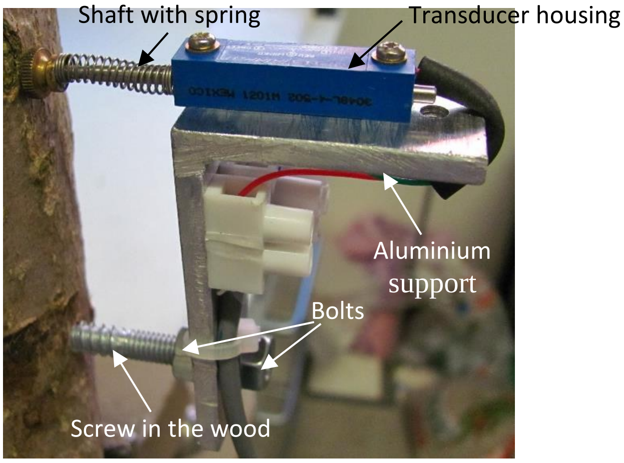

Fig. 2 – Point dendrometer

The output can be roughly converted into mm just on the base of the sensor electrical travel (*ET*):

$$mm = \frac{ET\ (mm)}{Exitation\ (mV)}\ output\ (mV)$$

However, a precise calibration is possible, a linear regression equation of several measured cursor shifts and corresponding outputs (fig. 3).

The regression slope (*m*) will be used as coefficient to convert the output:
$$mm = slope\ (m)\ x\ output\ (mV)$$

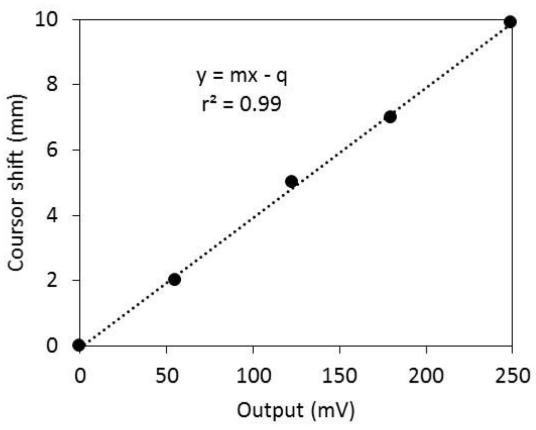

Fig. 3 – Calibration regression equation

The output can be easily recorded using any commercial data acquisition system (datalogger) and storing the data with a frequency set by the user, hourly or daily for instance.

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