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Application of Rotary sensor in Manure-grinding fertilizer spreader

Manure is a natural fertilizer. To make manure, decomposition of plants and animal waste is done by farmers. The product of this decomposition is a material rich in organic matter which we call manure. Manure does not have a high content of nutrients. Instead, it gives fertility to the soil by adding humus (organic component of the soil). This improves the soil's physical properties, with better retention of moisture and more aeration. And since manure is made entirely of organic materials it does not contribute to any form of pollution. In fact, it reduces waste on the farm, by decomposing waste materials to make manure.

The sensor is originally designed to work in a measurement booth in which any type of spreader could be calibrated. Under these laboratory conditions, two perpendicular velocity vectors and two associated major axes are measured. The resulting velocity vector is computed as the vector sum of the two perpendicular velocity vectors, and the particle diameter is computed as the mean of the two major axes. In addition, in the measurement booth configuration, the whole sensor is moved in a pattern. After each completed scan cycle (a semicircle around the spreader), the sensor is moved upward until the whole spreading zone is scanned.

By mounting the sensor permanently on a spreader, the user can obtain a real–time prediction of the spread pattern by having the sensor complete one or more cycles (semi-circles) around the spreader. The sensor may be a key factor in the development of feedback–controlled fertilizer equipment with which a high-quality spread pattern can be produced without calibration or adjustments by the operator. The objective of this study is to test the performance and feasibility of an optical sensor designed to automatically determine granular fertilizer spread patterns in the field.

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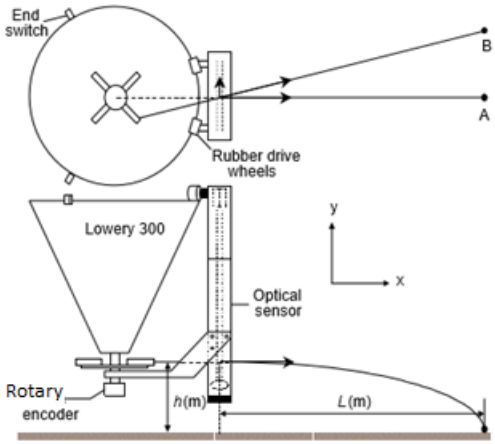

The sensor is mounted vertically with a horizontal bar that connects to a bearing in the centre of the impeller. It is moved around the spreader rim with two motors and rubber friction wheels. End switches are used to automatically alternate the direction of travel of the motors at the end of the cycle. In the centre of the spreader, underneath the impeller, a 12–bit rotary encoder is mounted, which measured the angle of the sensor relative to the centre of the impeller. The sensor mounting configuration implies that only the radial component of the particle's velocity vector is measured. One effect of this is that the measured spread pattern is rotated around the centre of the impeller, assuming that all particles have the same angle of emanation with respect to the impeller disc. A second effect is that the true velocity is always higher than the one measured, which means that the system is pessimistic in predicting the spread width. The latter error is non–linear since the relationship between velocity and landing position is non–linear.