*Int. Agrophysics, 1994, 8,565-566*

# VIEWING SYSTEM WITH RING-SHAPED SENSOR FOR ONE-LINE DETERMINATION OF THE GEOMETRY OF IRREGULARLY FORMED CONVEX OBJECTS*

*H. Gall*

Gartenstr. 6, D 18190 Groß Lüsewitz, Germany

A b s t r a c t. A principle of measurement of geometry of irregularly formed objects is presented. The ring-shaped sensor is based on the principle of a one-way light barrier. Sections of formed chords describe the contours of the objects. By movement of the object a spiral is formed which envelope the object. Simple calculating algorithms allow the precise determination of volume, axis measurements and shape of the object to be measured in real-time. The results show a high accuracy of the sensor principle.

K e y w o r d s: viewing system, geometry of convex objects, ring-shaped system, potato

## INTRODUCTION

Today sorting of agricultural products by using camera systems and computing techniques is difficult and cost a lot of money. Such systems are predominantly used for sorting according to colour. For the determination and sorting according to volume and shape for instance 3 camera systems are used or the products rotate in front of one camera system. Both possibilities are not so accurate, especially if the objects are of very irregullar form.

## MATERIALS AND METHODS

The sensor is based on the principle of a one-way light barrier. A high number of transmitters and receivers is advantageously equally spaced in the shape of a ring. In sequence all transmitters on the ring are activated and for each of them all receivers are sampled. Between every transmitter and receiver is a light barrier. The objects to be measured are seperately translatorily guided in preferably longitudinal direction through the sensor (Fig. 1). The position of the object in the range of the sensor is variable.

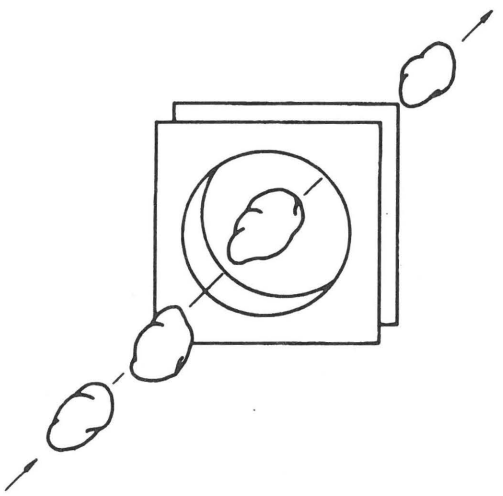

**Fig. 1.** Movement of objects through the ring-shaped sensor.

The light barriers which are not interrupted and are near the object are determined (Fig. 2). Sections of the formed chords describe the contours of the object. By the movement of the object one or two displaced spirals are formed which envelope the object (Fig. 3).

*This work was carried out in cooperation with Department of Electrical Engineering, Rostock University, Gartenstr. 6, D 18190 Gross Lüsewitz, Germany.

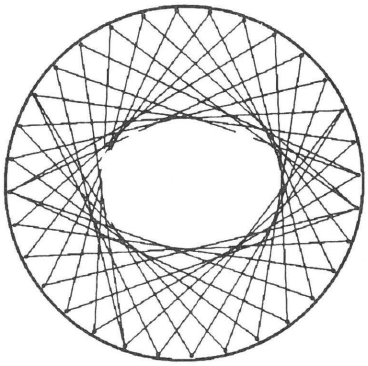

Fig. 2. Light barriers of one cross-section.

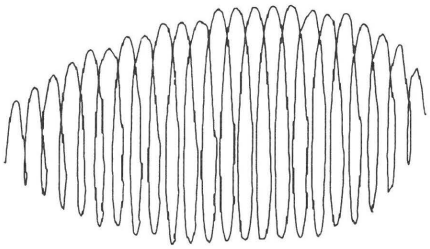

Fig. 3. Spiral enveloping an object.

Simple calculating algorithms allow the precise determination of volume, circumferences, axis measurements and shape of the object to be measured in real-time. A precondition is that the object is mainly of a convex-like shape, it may be angular or round. The accuracy of the measured object is directly proportional to the number of transmitters and receivers as well as to the relation in size between the object and the diameter of the sensor ring. The necessary computing power for the control of the sensor and the evaluation of data is low in comparison to camera systems. A test bench unit works with 64 transmitters and 64 receivers. The sensor rotates with 320 rounds per second. With an object speed of 1.5 m/s distances of 5 mm between the enveloping spiral sections are formed. For example, a potato seperator achieves - with an average tuber mass of about 80 g - a rate flow of 10 tubers per second or 2.9 t/h.

For first tests 6 different objects were positioned 12.0 cm above the sensor in longitudinal direction. Each of them fell down in different areas of the sensor for 25 times. Leaving the sensor the object speed amounted to 1.5 m/s.

## RESULTS

The coefficients of variation were determinated for volume and the three axis of objects (Table 1). The results show the high accuracy of the viewing system and of the principle of sensor usage.

**Table 1.** Coefficient of variation (%) of different objects

| Object | Length (cm) | Volume | Length | Big ⌀ | Small ⌀ |
|---|---|---|---|---|---|
| Ball | 7.5 | 2.30 | 0.96 | 0.66 | 1.08 |
| Ball | 7.0 | 2.77 | 0.51 | 1.68 | 1.70 |
| Ball | 3.3 | 12.54 | 2.14 | 3.90 | 1.91 |
| Body* | 10.0 | 2.05 | 0.87 | 2.03 | 1.82 |
| Lemon | 7.8 | 2.64 | 2.24** | 1.57 | 2.23 |
| Potato | 7.7 | 3.04 | 0.89 | 1.62 | 2.87 |

*Cylinder with concave area (corded up area) diameter 1= 6.0 cm, diameter 2 = 2.5 cm; **Stem of lemon was in the range of minimal resolution.

## REFERENCES

1. **Gall H., Farchmin U.**: Sensor zur Bestimmung geometrischer Abmessungen. Sensormagazin, Magazin Verlag, 4, 16-17, 1990.