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Limited-view Experiments towards a Practical Radar-based Microwave Imaging Prototype for Fruit Assessment

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Abstract — Food demand is forecasted to increase by as much as 98% by 2050, and consumers are becoming increasingly health conscious about their lifestyles and diets. Consequently, fruit and vegetable producers will face the challenge to produce high yield and quality products, and the current limitations with regards to assessing fruits’ internal quality brings forward the need to enhance existing quality assessment procedures. Currently these still largely rely on manual assessment, which is costly, time-consuming and subjective, while existing destructive technologies cause product wastage. Non-destructive imaging techniques including X-rays, magnetic resonance imaging (MRI), near infrared and Ultrasound have been applied and tested for automated fruit grading and sorting, but the drawbacks such as operational limitations in Ultrasound, high cost of MRI and safety issues in X-rays has limited their applications.

Microwave imaging has presented itself as an emerging nonionizing and non-invasive technology for a range of applications. Recent study by the authors has demonstrated that radar-based imaging algorithm has the potential to detect seeds inside selected fruits and can distinguish between seeded and seedless fruits [1], which is made possible due to the variation in dielectric properties between the fruit seeds and its surrounding flesh.

A realistic fruit imaging prototype requires optimization in imaging time, speed, cost and resolution. A complete 360 degree imaging of the individual fruits would not be straightforward in an environment where a continuous monitoring of a large quantity of fruits is required. For this purpose, this paper investigates and presents for the first time, the effects of reducing the number of views on the capability of a Huygens-based algorithm [2] to detect and locate the seeds inside the fruits. The results show that limiting the number of receiving views to 180 degrees does not affect the resolution of the detected target while further reduction of the views to 90 degrees only causes a minor offset in localization. This reduction in the number of receiving positions makes way for a design of a faster, cheaper and less complex imaging prototype.

REFERENCES