

FIRST Newsletter

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Advanced Image Processing Workflow for 3D Analysis and Visualization of Complex Multi-Phase Food Structure

The texture aspect of processed foods is a major criterion of sensory attributes that is critical for consumer acceptability and preference. Understanding texture perception requires knowledge of the food structure at the multiscale levels comprising microstructural elements of varying size and functionality, including oil and water droplets, fibers, fat, ice crystals, and gas bubbles.

3D X-ray microscopy (XRM) offers the possibility to visualize and characterize such microscopic features in various food materials. However, some food materials remain challenging to characterize through image processing because of their small or similar attenuation coefficient, making them difficult or impossible to be segmented by regular image processing methodology (Figure 1).

[Method Note 135](#) presents an automatic image processing workflow through CTAn (version 1.19.11.1) for segmentation and 3D analysis of the various phases in potato crisp. The methodology includes the step by step process to (i) delineate the volume of interest (VOI) for 3D analysis, (ii) segment the crisp medium from air and oil inside the VOI,

(iii) improve contrast between air pores and oil droplets, (iv) isolate oil droplets from air pores, and (v) analyze in 3D the segmented crisp, air and oil inside the VOI to determine for each phase the volume proportion and thickness distribution.

The results of this phase retrieval applied to the sorghum root scan is also shown in figure 1 (b). The notable feature of phase retrieval imaging is the elimination of the artificial edge brightening and its conversion into enhanced contrast. Thus, for example, the higher density of a layer of peripheral cells in the root is shown by phase retrieval, but is not visible in the reconstruction of standard absorption based projections.

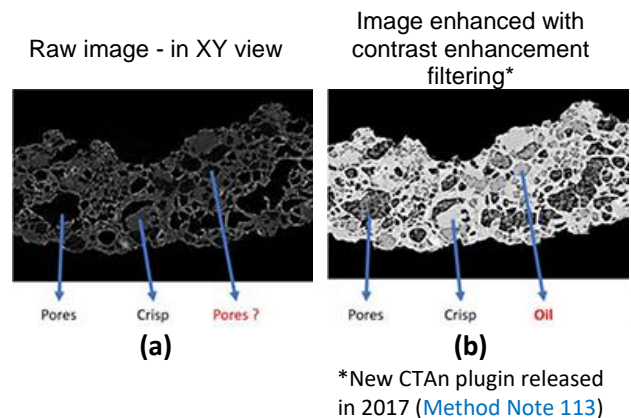


Figure 1. Microstructural XRM image of a potato crisp, showing areas of texture, pores, and oil.