Making the Grade

SCOTT BAUER (K7252-25)

A great-looking apple is no guarantee of great taste. Internal defects are difficult—if not impossible—to detect. USDA inspectors sample apples to gauge taste and other quality factors. But if they so much as pick up an apple, it has to be discarded. And there are grading tests done on sample apples when they are first bought from growers, before the fruit ever reaches the packing line. But, again, all those tests require destroying (or eating) the apple—which means the ones tested are guaranteed to be the ones we never get to eat.

So Renfu Lu, an ARS agricultural engineer working in Michigan, the third-largest U.S. apple-producing state, is using remote sensing techniques borrowed from NASA and the military to do an automatic, hands-off sampling of every single apple before it gets to your hands—or mouth.

Washington State produces almost half the nation's apples—and is partially funding Lu's work—while New York and Michigan together produce another 20 percent of the annual crop. Lu's research is critical to these and all other U.S. apple-producing areas.

After joining the ARS Sugarbeet and Bean Research Unit in East Lansing, Michigan, in 1999, Lu visited packinghouses in Michigan and Washington to help him understand industry's needs.

Apple packinghouses currently rely on digital camera imagery to sort apples by surface appearance only, flagging those that are visibly defective or the wrong size or color.

"That system is literally skin-deep," Lu says. "It can't detect bruises beneath the skin."

Lu proposes looking deeper with a system that uses the latest imaging spectroscopy techniques. These combine the digital camera's conventional two-dimensional imaging with spectroscopy to analyze various wavelengths of reflected light. This method can discern subtleties in an object's features—whether it's terrain, camouflaged Army tanks, or apples.

Lu's system would bounce light off apples one at a time as they pass by on processing lines. The returning light would be detected by an imaging spectrometer to create a spectral image of the apple on a computer screen. Specially designed software would allow the computer to sort the apples by internal quality attributes required for various grades.

Lu's tests have shown that his system can detect bruises deep within the apple's flesh. But first he is focusing on the top two things that make a great-tasting apple—sugar content and firmness. Lu developed mathematical equations that relate sugar content to the amount of light absorbed by an apple and firmness to the amount of light bounced off the apple. He hopes to expand the system to detect acid content.

Industry studies have shown there to be different demands for various types of apples, Lu says. "Oldsters tend to prefer softer, sweeter apples, while youngsters like them hard and sour," he says. "With a taste- and firmness-sorting system, each apple gets to the right person."

Lu is confident that his work with apples—and cherries, too—will be easy to adapt to oranges, peaches, or pears. His system could be merged with current digital imagery systems with very little modification.—By **Don Comis,** ARS.

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