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Challenges and solutions of optical-based nondestructive quality inspection for robotic fruit and vegetable grading systems: A technical review

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12 **ABSTRACT**

13 **Background**

14 Optical techniques, including computer vision, spectral imaging, near-infrared
15 technology and other emerging imaging and spectroscopy techniques, have been
16 rapidly developing and widely applied in fruit and vegetable grading systems for
17 nondestructive quality inspecting and grading over the past decades. However,
18 automatic detection of quality and grading is still difficult due to some still existing
19 challenges, which are the key of blocking their commercialization in robotic fruit and
20 vegetable grading systems. The challenges include the following aspects: the
21 influence of physical and biological variability, whole surface detection,
22 discrimination between defects and stems/calyxes, unobvious defect detection,

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