

"In-field apple size estimation using photogrammetry": a new article of the PAgFRUIT research project

The PAgFRUIT research team has just published an article about apple size estimation using photogrammetric techniques. The paper, titled **In-field apple size estimation using photogrammetry-derived 3D point clouds: Comparison of 4 different methods considering fruit occlusions**, has been published in *Computer and Electronics in Agriculture* (Elsevier), and the authors are Gené-Mola, J., Sanz-Cortiella, R., Rosell-Polo, J.R., Escolà, A. and Gregorio, E. In this paper, a novel methodology for automatic in-field apple size estimation is proposed. It is based on four main steps: 1) fruit detection; 2) point cloud generation using structure-from-motion (SfM) and multi-view stereo (MVS); 3) fruit size estimation; and 4) fruit visibility estimation. Four techniques were evaluated in the fruit size estimation step. The first consisted of obtaining the fruit diameter by measuring the two most distant points of an apple detection (largest segment technique). The second and third techniques were based on fitting a sphere to apple points using least squares (LS) and Mestimator sample consensus (MSAC) algorithms, respectively. Finally, template matching (TM) was applied for fitting an apple 3D model to apple points. The best results were obtained with the LS, MSAC and TM techniques, which showed mean absolute errors of 4.5 mm, 3.7 mm and 4.2 mm, and coefficients of determination (r^2) of 0.88, 0.91 and 0.88, respectively. Besides fruit size, the proposed method also estimated the visibility percentage of apples detected. This step showed an of 0.92 with respect to the ground truth visibility. This allowed automatic identification and discrimination of the measurements of highly occluded apples. The main disadvantage of the method is the high processing time required (in this work 2760 s for 3D modelling of 6 trees), which limits its direct application in large agricultural areas. Link to the article: <https://doi.org/10.1016/j.compag.2021.106343> [<https://doi.org/10.1016/j.compag.2021.106343>].

