2D vision based measuring device for teat morphology in dairy cows

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Teat morphology is an important parameter in choosing the most appropriate teatcup liner for a herd since the interaction between teat and liner can strongly affect the milking characteristics and udder health. Nevertheless, information on teat morphology is very scarce and rarely sufficient for liner selection. Gathering information on large scale with current techniques is time consuming, subjective and not always accurate. However, the ability to measure teat parameters in an easy way and on large scale has many applications. This study presents a new vision based measuring technique for teat shape parameters. A camera is used to obtain a 2D image of the teat and image processing analyses to determine teat length and diameters. In addition, shape parameters of teat and teat end can be defined. The resolution in length and diameters is better than 0.5 mm. The error on the length of the teats that make an angle in the longitudinal plane of maximum 25° towards the camera, is no more than 5 %. To validate the repeatability of the measuring method, the teats of one Holstein cow were measured 5 times by 8 different members of a test panel of which 5 people were experienced in working with cows. Reproducibility was tested by measuring the teats of 7 Holstein cows by the same test panel. The teats of each cow were measured once in a defined order. The sequence in which the members measured the teats was randomized. No significant differences were found between the 5 successive measurements of one person on 3 teats. Significant differences in left-front teat measurements ($p=0.002$) were due to the lack of cow experience ($p=0.022$). Teat length measurements did not significantly differ between members of the test panel as long as teats could be easily reached. However, no significant differences were found for all teats between operators familiar with cows. In conclusion, a new accurate, repeatable and reproducible method was developed to measure teat parameters in all kinds of milking parlours. To obtain repeatable and reproducible results, some training in working in close interaction with cows is advised.