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A classification system of bamboo based on the digital image processing of its mesostructure

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Abstract – Bamboo has being widely used as building material throughout Latin America and tropical Asia. From traditional buildings to innovative architectural projects, bamboo has shown its suitability based on a combined low weight, high strength, beauty and durability. A successful application of bamboo in engineering firstly relies on the selection of a correct plant. Traditionally, bamboos are visually classified based on external anatomical characteristics and microscopic features [1,2]. The vascular bundles shapes and their arrangement within the cross sections of the culm can provide valuable data to classify bamboos. Using digital image processing and pattern recognition techniques, a supervised classification procedure of bamboo vascular bundles was developed and tested on polished cross sections of bamboo culms from four different species, with results consistent with visual observations.

Polished cross sections of bamboo culms from 4 different species were imaged through optical microscopy (6x) and a video camera connected to a computer. Then, using KS400 [3] for image processing and MatLab [4] for classification, a supervised classification procedure was developed. The vascular bundles are complex objects, formed of different numbers of sclerenchyma regions with various shapes, depending mainly on the bamboo species and on the radial distance inside the culm section. Sclerenchyma is easily threshold-segmented from the surrounding parenchyma, but it is not easy to understand a set of these regions as a vascular bundle. Thus, the segmentation of vascular bundles was the critical step. It was carried out by a recursive clustering procedure. This procedure clusters sclerenchyma regions using the Valleys [5] segmentation method. At each cycle, obtained vascular bundles are evaluated through their relative size and the well-segmented ones are separated and stored. This process repeats, modifying the two Valleys input variables, until reaching an optimum point. Drawings provided by Taihui and Wenwei [2] were used as training set for classification. The shape of vascular bundles was characterized by the number of sclerenchyma regions and by the ratio of the largest region convex hull to the vascular bundle convex hull multiplied by the largest region aspect ratio. A distance classifier was used. Results for the same species samples were similar and were consistent with visual observations. Further studies should include classification of the main bamboo species used as construction material.

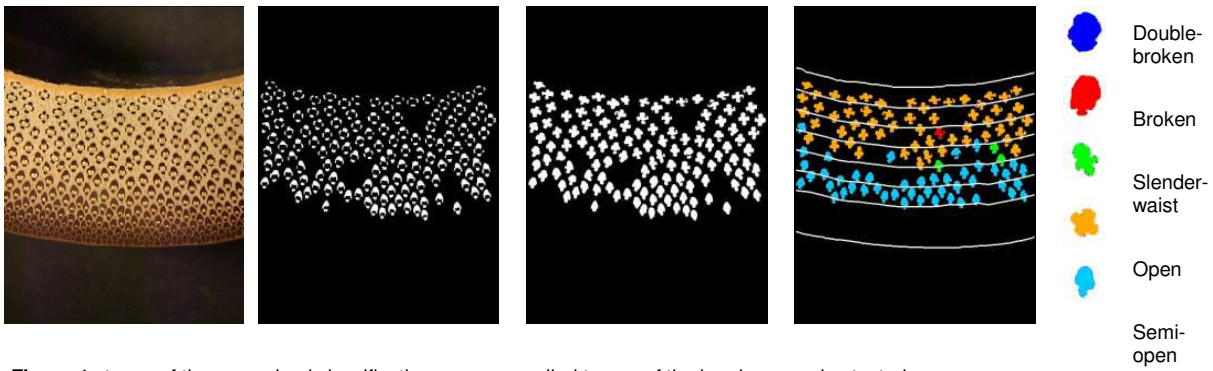

Figure 1 stages of the supervised classification process applied to one of the bamboo species tested

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