APPLICATION OF IMAGE MEASUREMENT AND CONTINUUM MECHANICS TO MEASURING THE LARGE–STRAIN KINEMATIC BEHAVIOUR OF PREPARED SUGAR CANE AND BAGASSE

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ABSTRACT

This thesis presents an investigation into the application of numerical image measurement techniques and fundamental continuum mechanics to measurement of the large strain kinematic behaviour of prepared sugar cane and bagasse.

A generic, stand–alone software tool was created for measuring the two–dimensional finite strains of solid–phase historic continua, via time series of digital images from filmed experiments. This software, referred to for simplicity as *Image Tensor Analysis (ITA)*, combines numerical image displacement measurement using the FFT direct cross–correlation, with the classical theory of continuum mechanics, to produce transient kinematic and material output that is concurrent with Lagrangian finite element models. The ITA software presents a new platform for data acquisition from prepared cane and bagasse experiments, as well as providing a means for proofing finite element simulations of bagasse milling. Furthermore, the accurate measurement of fibre kinematics, coupled with mechanical data, provides sufficient information for estimating parameter values within the solid–phase material model, with a reverse finite element procedure.

A small series of confined flat–platen uniaxial compression experiments were conducted and the ITA software was calibrated for the complex fibro–porous process materials, prepared sugar cane and bagasse. Problems with experimental procedures were identified and a subsequent series of experiments conducted. Refined experimental practice resulted in improved initial sample homogeneity and repeatable sample deformation measurements. The ITA software was also employed in an investigation into bagasse behaviour during compression between grooved surfaces, providing insight into juice flow through the bagasse fibre blanket.

A series of two–roll milling experiments were conducted, with the aim of quantifying the deformation behaviour of prepared cane and bagasse during rolling. The experiments were inhibited by apparatus limitations, resulting in poor repetition of the deformation measurements. However, the ITA software was shown to be capable of measuring the large biaxial material strains, and solid conclusions were made in regard to the kinematic behaviour of the solid–phase fibre. It was identified that improved apparatus is required to obtain suitable ITA deformation results for direct comparison with finite element simulations of the two–roll milling regime.

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