Public Abstract

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Title:EXPERIMENTAL AND NUMERICAL INVESTIGATION OF BIOMASS MECHANICAL PRE-PROCESSING

In this study, mechanical properties of switchgrass and miscanthus were determined by tensile, compressive and shear tests in longitudinal (along the fiber) and transversal (cross the fiber) directions with special designed tools. A linear cutting platform and a data acquisition system were developed to investigate the biomass cutting performances using conventional cutting and ultrasonic-assisted cutting. Three different blades with 20 kHz vibration frequency were designed by using finite element analysis and verified by experimental modal analysis. Finite element analysis models of biomass cutting were developed to simulate the biomass cutting process. The simulation results showed that finite element analysis method could be used to design the ultrasonic blade and simulate the biomass cutting process. Biomass cutting experiments were carried out to investigate the effects of cutting speed, shear angle, blade profile and ultrasonication on the cutting force and energy consumption of switchgrass and miscanthus cutting. Experimental results showed that ultrasonic cutting could reduce the cutting force and the entire cutting energy consumption. The optimized energy consumption could be achieved when the cutting speed was about 1/3 of the ultrasonic blade vibration speed. For the biomass conventional cutting, the tested cutting speeds did not show obvious effects on cutting performances.