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Model of three-dimensional reconstruction and visualization of agricultural samples based on parallel algorithms and graphical library VTK

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This work presents a new method for three dimensional (3D) image reconstruction dedicated to the investigation in soil physics by means of X-ray tomography. The conception of the 3D model for reconstruction and visualization was based on the filtered back projection algorithm, operating under parallel environment together the insertion of virtual planes between pairs of real planes obtained by X-Ray tomography under energies varying from 56 keV to 662 keV. In this model, the virtual planes were generated by interpolation with the use of B-Spline-Wavelets. The evaluation of the 3D reconstruction model was established by using a set of agricultural samples (i.e., soil, glass, wood and calibration phantoms) having different configuration for the planes. Such configuration was based on setting not only the sizes and the number of the real but also the virtual planes in the volume. This procedure allows the impact measurements as a function of the increasing in workload and the communication granularity. To validate the reconstruction model, a dedicated parallel architecture composed of 4 DSP processors connect to HEPC2E board was used. This board enables data exchange between DSP processors and communication with host computer. A measurement of efficiency with a speed up equal to 3.4 was obtained using the same set of samples and a better performance was observed with a higher number of planes. Additionally, 2D and 3D visualization tools based on Visualization ToolKit (VTK) were included in order to help users to analyze reconstructed images and their characteristics. It is distinguished that the use of VTK library brought improvements in functionalities, enabling the visualization of sagital, coronal and transversal slices as well as the visualization of volumes of interest. Besides, the interpolation of virtual

plans through the technique of interpolation for B-Wavelet revealed adequate to the model, mainly when the quality gotten in the generation of the interpolated plans is taken in consideration. Results have shown that the 3D parallel model reconstruction brought original contributions for the soil science diagnosis by X-Ray tomography, as well as to explore the available computational resources in parallel architectures, which demands great processing capacity.

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