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3D reconstruction of soil samples: an automated sequential removal technique

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A new mechanical tomography system aiming at achieving 3D reconstruction and analysis of the soil structure is described here. Undisturbed soil samples are impregnated with a polyester or epoxy resin after a dehydration treatment. A fluorescent dye is added in the resin. The hardened soil blocks are ground under a high precision (1 micron) surface-grinding machine and 2D images of serial sections are acquired using a digital photo camera (3872x2592 pixels). The usually long time consuming work of grinding and acquiring has been completely automated. Different light sources can also be activated automatically. The information on the 2D sections is rearranged on a graphic workstation in order to reconstruct a 3D image of the soil block. Reconstruction is made using 2D sections spaced by the same amount of the pixel size allowing a reliable 3D representation of the soil features with an isotropic grid of voxels. Analysis on porosity, pore size distribution, connectivity etc. can then be performed using algorithms of mathematical morphology. Discussion on the results on a trial experiment demonstrates that the system offers an useful and "sustainable" instrument to obtain information on 3D organisation of the soil pore geometry and other soil features.