

## *New Method for Measuring Bulk Density in Soils with Large Coarse Fragments*

### ■ SUMMARY

A new method for measuring soil bulk density using three-dimensional photogrammetric models has been developed.

### ■ SITUATION

Bulk density is an important fundamental property of soil. It is the main indicator of soil porosity, soil compaction, and is used as a factor in estimation of the content of many soil constituents measured as concentrations, for example soil organic carbon content. While the mass of a soil sample is easily measured in the field (using a portable balance) and the laboratory, volume is more difficult to measure. Traditional methods involve filling a sample excavation with water, sand or polystyrene foam; the volume of these can be measured. These methods do not work well with soils containing large coarse fragments of rock or organic matter, and are especially inaccurate and time consuming when the soil surface is irregular or has protruding rocks. A more accurate and convenient method for measuring volume of a small soil excavation would find wide applicability.

### ■ RESPONSE

Two modern methods for estimating the volume of an excavation accurately are being developed. In the first method a laser profilometer can be used to model the three dimensional shape and hence the volume of an excavation. The disadvantage of this method is equipment cost and complexity. I have been developing a much simpler method using digital photogrammetry. Overlapping photographs of the soil surface and the surface of excavation are made using a high resolution digital camera, and a three dimensional photogrammetric model constructed using Photomodeler software. From the model, an accurate measurement of the volume of the excavation can be made automatically, regardless of the shape or size of the excavation or the irregularity of the surfaces.

### ■ IMPACT

The method promises to improve the convenience and accuracy of field measurements of soil bulk density and consequently enhance the quality and reliability of many measurements of important soil properties including soil organic carbon which are needed for understanding and managing the soil resource and associated environmental quality.



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