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Non-Invasive Property Analysis of Heterogeneous Media Samples: How Small is Too Small?

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Soils, and other heterogeneous media, present challenges for small sample sizes due to increased uncertainty about overall representation of the wider physical characteristics. Little guidance exists around the size samples should be to avoid overall (compared to bulk samples) and local (within the sample) heterogeneity influences. De-Ville et al. [1] presents a summary of appropriate sample size suggestions, with Rab et al. [2] suggesting only a minimum sample diameter of 50 mm for soil science investigations. De-Ville [4] presents evidence that in a Green Roof Substrate (growing media) a 50 mm internal diameter sample size is representative of a larger standard sized 150 mm sample. Whether sample sizes can be reduced beyond this 50 mm limit whilst maintaining a larger scale representation remains to be seen.

The smallest acceptable sample size is thought to be largely dictated by the largest particle (or soil aggregate) diameter. Other studies of heterogeneous media, as created from glass spheres of varying diameter, suggest that the effects of heterogeneity are minimised for samples where the core diameter is 2-20 times the largest particle diameter [3].

This study utilises X-Ray Computed Tomography, a powerful tool for the non-destructive exploration of the internal structures of heterogeneous media, to examine the relationships between physical sample size, image resolution, and physical property characterisation. In order to achieve good characterisation of physical properties the X-Ray image resolution needs to be high, this requires small sample sizes. Samples of varying diameter and composition are analysed to establish links between sample and soil aggregate diameter ratios and quantifiable heterogeneity. This information will help guide soil sampling strategies for non-invasive analysis by determining an optimum sample size based on soil physical characteristics.

References

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