
Cross-scale 3D characterisation of complex and heterogeneous geomaterials with X-ray micro-CT

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Abstract

Many construction and geomaterials contain both very fine and coarse structure, so that effective characterisation and modelling of such materials demands information on a large range of length scales. A single 3D image (from e.g. X-ray micro-CT) can only cover a limited range of length scales: for example, a cubic image containing 1 TeraVoxel - larger than any instrument can acquire today and impractical for direct modelling - has only 10,000 pixels per side, insufficient for more complex or heterogeneous materials. We present recent advances in 3D imaging capabilities, particularly X-ray micro-CT, considering the overall state of the art and focussing on developments in our laboratory. We discuss methods for cross-scale 3D characterisation, including (a) acquiring individual images with the highest fidelity and resolution, (b) acquiring multiple images of a particular sample at multiple scales, (c) using image registration to build spatial maps between micro-CT and complementary 2D and 3D techniques such as SEM and SEM-EDS, and (d) developing workflows for modelling that combine the information from these sources.

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