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TOMOLAB: a new X-ray microtomography facility for geosciences applications

S. Favretto (1), G. Schena (2)

(1) Materials and Natural Resources Department, University of Trieste, Italy, (2) Civil and Environment Engineering Department, University of Trieste, Italy (sfavretto@units.it / Fax: +39 (0)40 5583497)

Computed microtomography (μ-CT) is one of the most advanced techniques in the field of non-destructive evaluation tests. It allows imaging of the internal microstructure of the rock and soil pore space, measuring the three-dimensional X-ray attenuation coefficient map of the sample. TOMOLAB is a custom-developed cone-beam CT system equipped with a sealed micro-focus X-ray tube. Due to the optimal combination of the source and detector characteristics, the facility is specifically designed to inspect high absorbing samples, such as rocks, reconstructing their internal features with a nominal spatial resolution of few micrometers.

Our facility TOMOLAB is located at the ELETTRA synchrotron laboratory in Basovizza, Trieste. It represents a versatile and ready to use instrument available both for research purposes and industrial users. When special requirements are needed, deeper investigation can be carried on with synchrotron light at the X-ray imaging beamline of ELETTRA.

However, in most of cases the resolution is proved to be suitable enough for a detailed insight on the rocks and soils textures. Single gray-scale slices as well as the entire digital volume of the rocks pore space are created and subsequently analyzed by home-developed codes based on modern image processing algorithms. The main aim is the geometrical, topological and morphological characterisation of the pore space by measuring all the parameters useful to describe both the hydrogeological and petrophysical properties such as porosity, grain size distributions, tortuosity and the fluid behavior (i.e., permeability and capillary pressure curves).

The intensive 3D image analysis method allows the identification of the fluid paths

inside the porous medium; thus it opens the way to solve by a direct approach single or multi-phase fluid flow simulations for petroleum recovery purposes as well as contaminated groundwater remediation or others different environment related problems.

In this paper we present some examples of high quality images of sandstone reservoir rocks, volcanic ones, artificial concrete and unconsolidated soil obtained at the TOMOLAB station. Then, we describe our method to retrieve from the digital volumes the set of morphological measurements we need to calculate the fluid permeability.

Keywords: microtomography, digital imaging, pore space, fluid flow.