Measuring morphological and topological characteristics of fluids in porous media: Applications to environmental science and engineering problems

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This presentation will give an overview of the current state of imaging of porous media systems—and fluid-related processes taking place within them— using x-ray tomography, a technique that allows for three-dimensional observation and measurement of variables internal to an otherwise opaque object.

X-ray tomography has advanced to the point where it is possible to probe porous media in great detail, allowing for fully quantitative analyses of processes and mechanisms at the scale of the individual pore. Detail resolution ranges from hundreds of microns for cm-sized samples down to hundreds of nm for micron-sized objects. Contrast depends on density and atomic number of the imaged object, and creative use of contrast agents can help delineate otherwise difficult-to-identify features. Also discussed will be technique limitations, as well as new potential advances that will allow for exciting new research in coming years.

The technique allows us to characterize fluid flow in porous media in unprecedented detail. Allowing for not only porosity and pore network characterization, but also fluid saturation, interfacial areas and curvatures, and shape parameters (topology). Applications of the technique to remediation of contaminants in groundwater, and geologic sequestration of CO_2 will be presented.