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## Combining CT Scan and Particle Imaging Techniques: Developing New Applications to Sediment Transport

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Physical models were built to study sediment transport in coastal and fluvial environments. X-Ray computed tomography (CT) technology has useful applications in geosciences providing density and porosity of non-homogenous materials. The medical CT scanner is interesting because of its large opening, allowing a field of view up to 65 cm for the reconstructed image. Dynamic systems could also be studied with the CT scan by doing temporally resolved measurements. This project uses optical imaging techniques to characterize the effect of different flow types (i.e., uniform flow and waves) on sediment transport.

A movable sand-bed model was built in the Multidisciplinary Laboratory of CT Scan for Non-Medical Use at the Institut National de la Recherche Scientifique (Québec, Canada). A rectangular flume (0.30 m x 0.30 m x 7.0 m) made with 0.025 m thick transparent acrylic material was inserted into a medical X-ray CT scanner (Siemens, Somatom Definition AS+ 128). The CT scanner moves on 2.6 meters rails along the flume. For preliminary tests, the water depth in the flume is 0.14 m. The sand bed is composed of quartz (SiO<sub>2</sub>), Ottawa sand, with grain median diameter (d<sub>50</sub>) of 217 μm and uniform density. The bed height is 0.05 m. In addition, as the examination table is static and the gantry moves along the object, the use of large fixed physical models is possible. Steady flow can be created using a water pump joining the two water tanks placed at each extremity of the flume. A honeycomb diffuser reduces the turbulence at the water inlet. A wavemaker can also be installed at one extremity to generate waves. A wave absorber made of angular pebbles is placed at the other extremity. A particle image velocimetry (PIV) measurement system is mounted on the CT scanner allowing time-synchronized and co-located measurements. The camera is protected from the X-ray by a lead sheet.

The method consists of coupling a medical CT scanner and a particle image velocimetry (PIV) system. The two datasets are combined to provide an image with density values as well as velocity vectors, and the PIV system can be successfully synchronized with the CT scanner. With this settings, fundamental information can be gained to understand the physics of particle-fluid dynamics and improve the modeling of the underlying processes. This experimental set up allows for the parameterization of shear velocity and sediment density at the boundary layer, which is an essential but otherwise difficult to determine parameter of sediment transport.

### Country/Organization invited to participate

Canada

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