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Interface fluctuations during rapid drainage

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We experimentally study the interface dynamics of an immiscible fluid as it invades a monolayer of saturated porous medium through rapid drainage. The seemingly stable and continuous motion of the interface at macroscale, involves numerous abrupt pore-scale jumps and local reconfigurations of the interface. By computing the velocity fluctuations along the invasion front from sequences of images captured at high frame rate, we are able to study both the local and global behavior. The latter displays an intermittent behavior with power-law distributed avalanches in size and duration.
As the system is drained potential surface energy is stored at the interface up to a given threshold in pressure. The energy released generates elastic waves at the confining plate, which we detect using piezoelectric type acoustic sensors. By detecting pore-scale events emanating from the depinning of the interface, we look to develop techniques for localizing the displacement front. To assess the quality of these techniques, optical monitoring is done in parallel using a high speed camera.