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# Influencing factors of seismic uplift response of buried pipelines in liquefiable soils

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## Objectives

Taking Yuxi Section of the second phase of Yunnan-Central Water Diversion Project as an example, the dynamic response of pipeline buoyancy under earthquake action is studied in order to improve the seismic performance of long-distance water transmission pipeline system.

## Methods

Based on OpenSees finite element software, the seismic wave is selected by target response spectrum and spectrum matching method, and the dynamic response of pipeline floating under earthquake is simulated by considering different characteristics of pipe soil and ground motion.

## Results

(1)The smaller the relative density of soil, the larger the diameter of pipe, the shallower the buried depth of pipe, and the greater the risk of pipeline floating damageThe empirical fitting formula of relative density of soil mass, diameter of pipe and buried depth of pipe to floating displacement of pipe.

(2)When the ground motion amplitude is the same (PGA=0.3g) and the response spectrum shape is basically no difference, the floating displacement of pipeline under long holding ground motion is about twice that under short holding ground motion, and the liquefaction duration is about 2.5 times that under short holding ground motion.

(3) Two failure modes exist simultaneously under the action of near-fault pulse ground motion: upward failure and lateral failure. Due to the short duration and high peak velocity of the pulse wave, the pore pressure in the liquefaction site dissipates quickly, resulting in the risk of pipeline floating damage being less than that of non-pulse ground motion. Due to the strong velocity pulse effect, the risk of pipeline lateral damage is greater than that of non-pulse ground motion.

## Methods

The relative density of soil, the diameter of pipe and the buried depth of pipe have great influence on the floating reaction of pipe. The excess pore water pressure dissipates slowly under long-term ground motion. Under the action of near-fault pulse ground motion, two failure modes of pipeline floating failure and lateral failure exist simultaneously, and the risk of pipeline lateral failure is greater than that of pipeline floating failure.

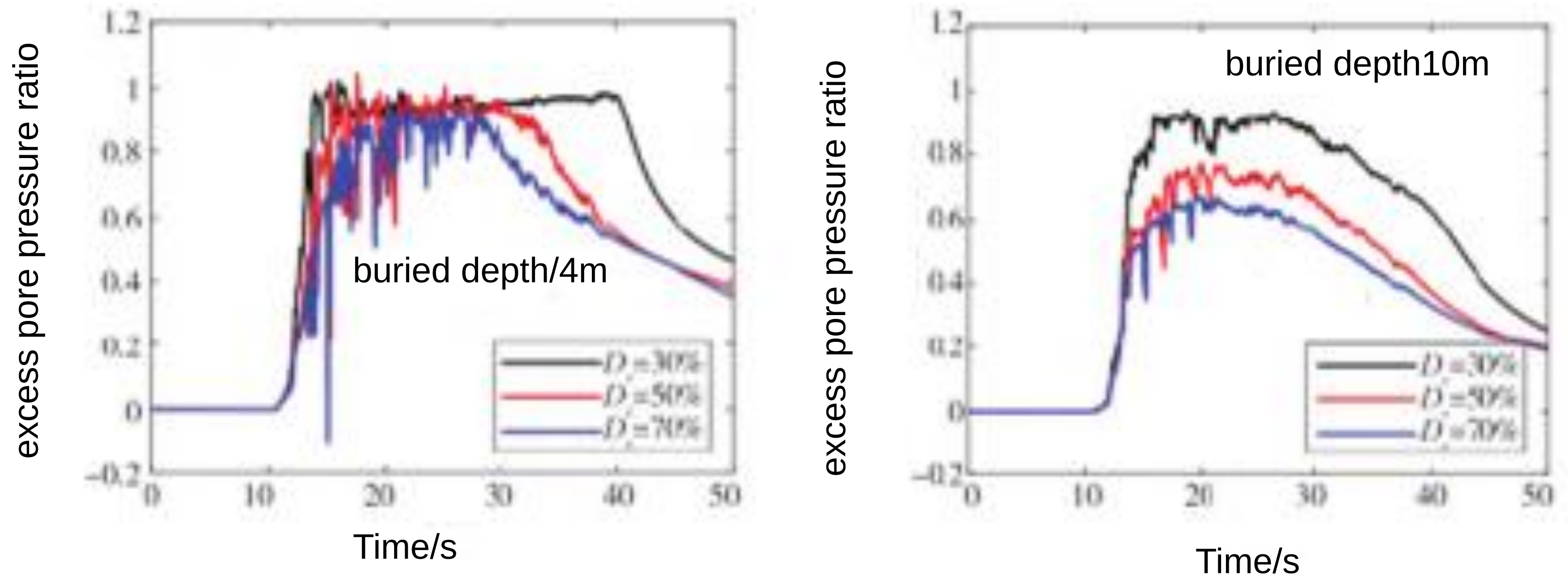
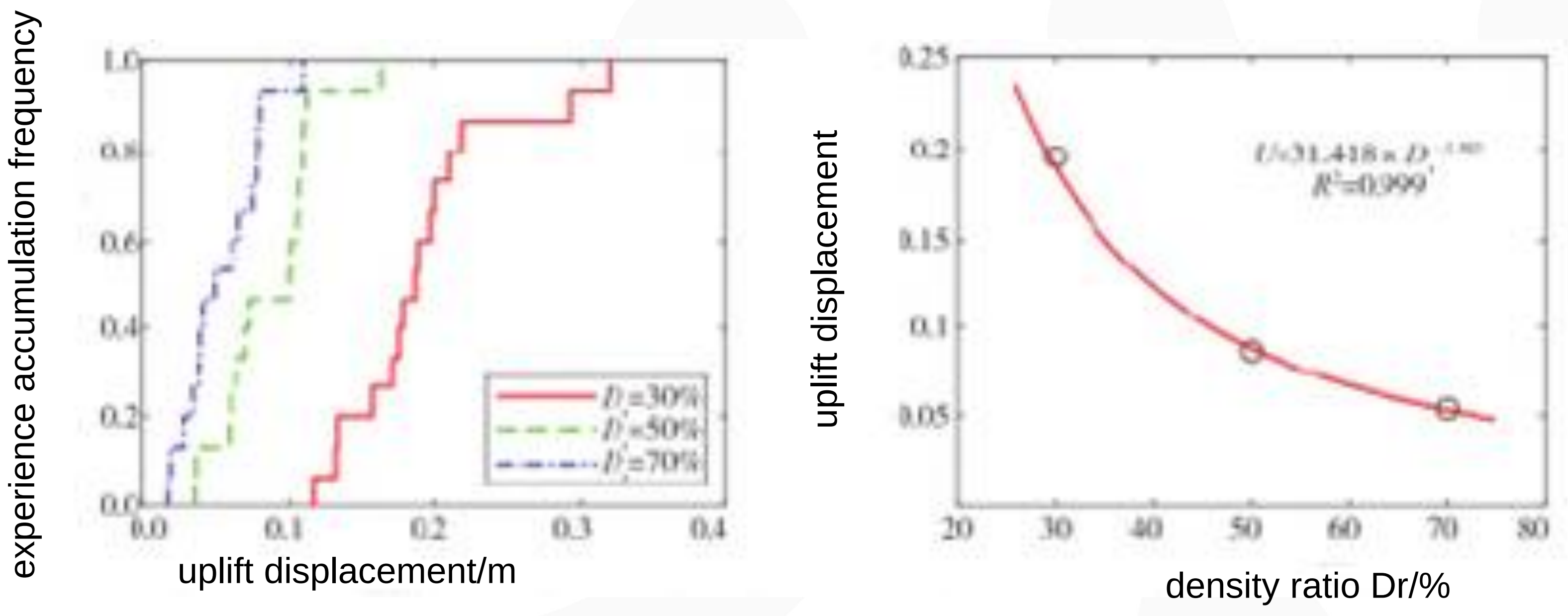
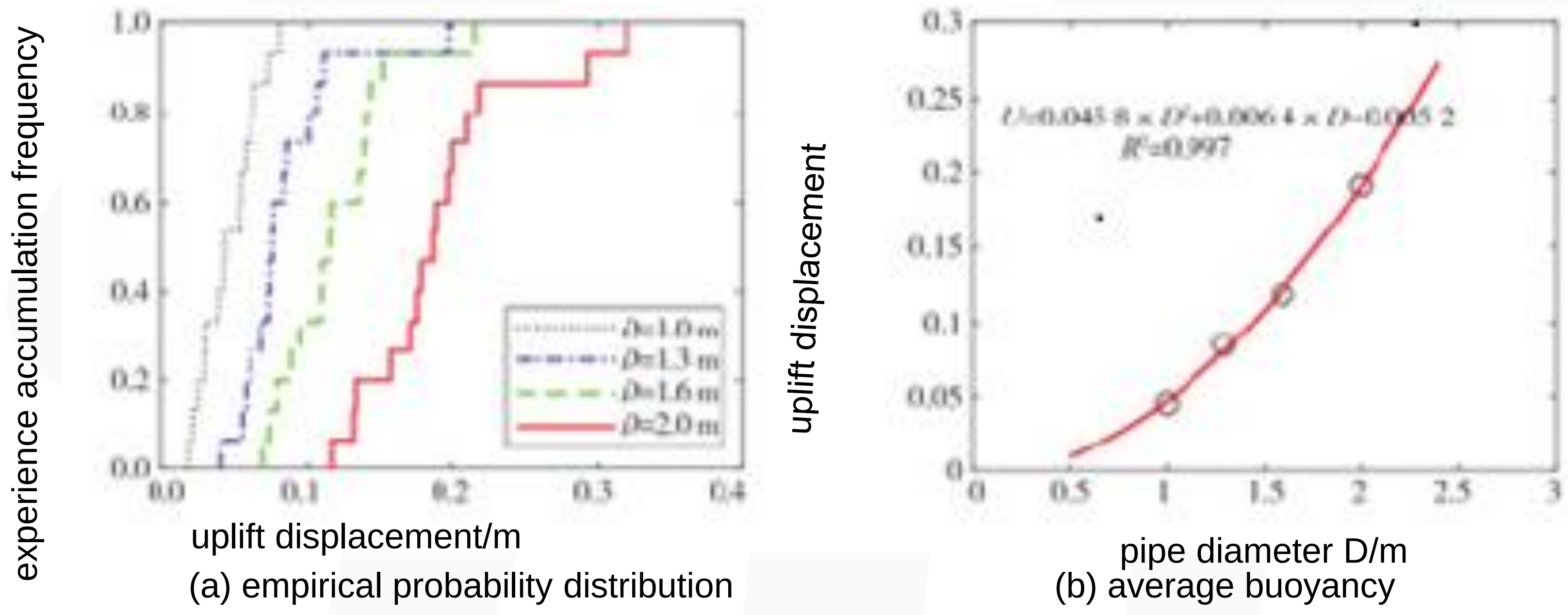


Fig. 1 Effect of density ratio of soil on pore pressure



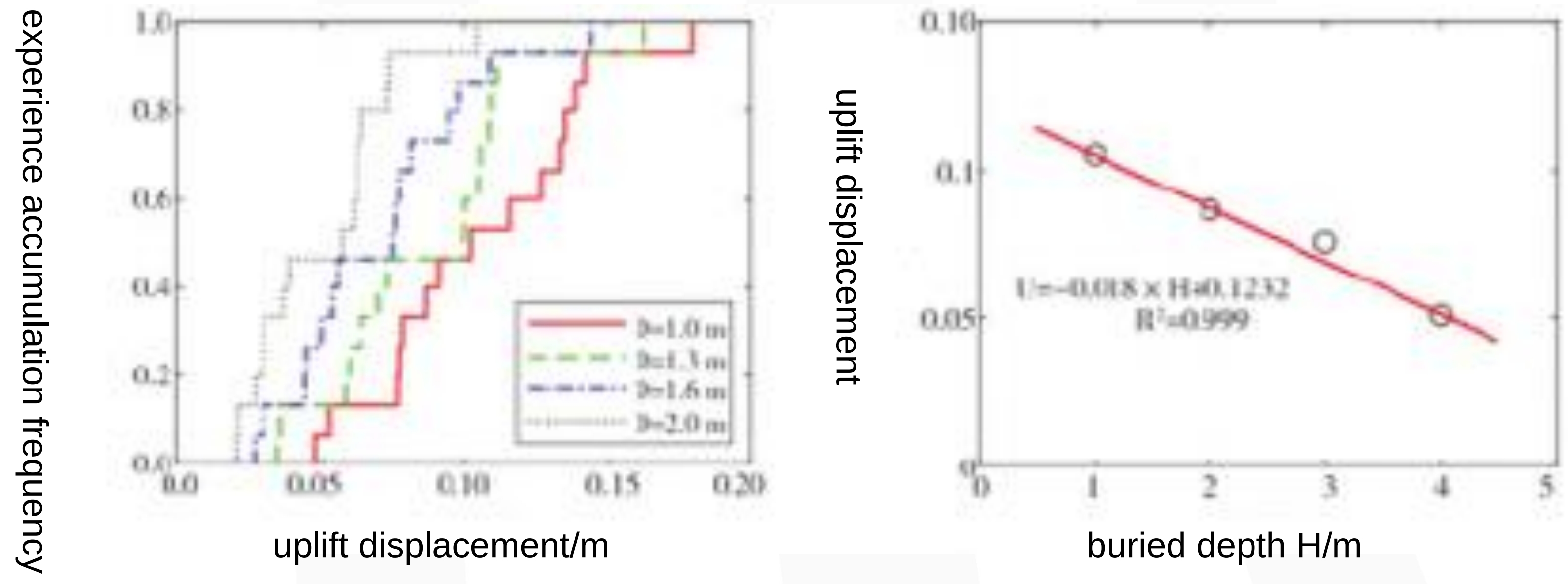
(a) empirical probability distribution
(b) average buoyancy

Fig. 2 Effect of density ratio of soil on pipe uplift



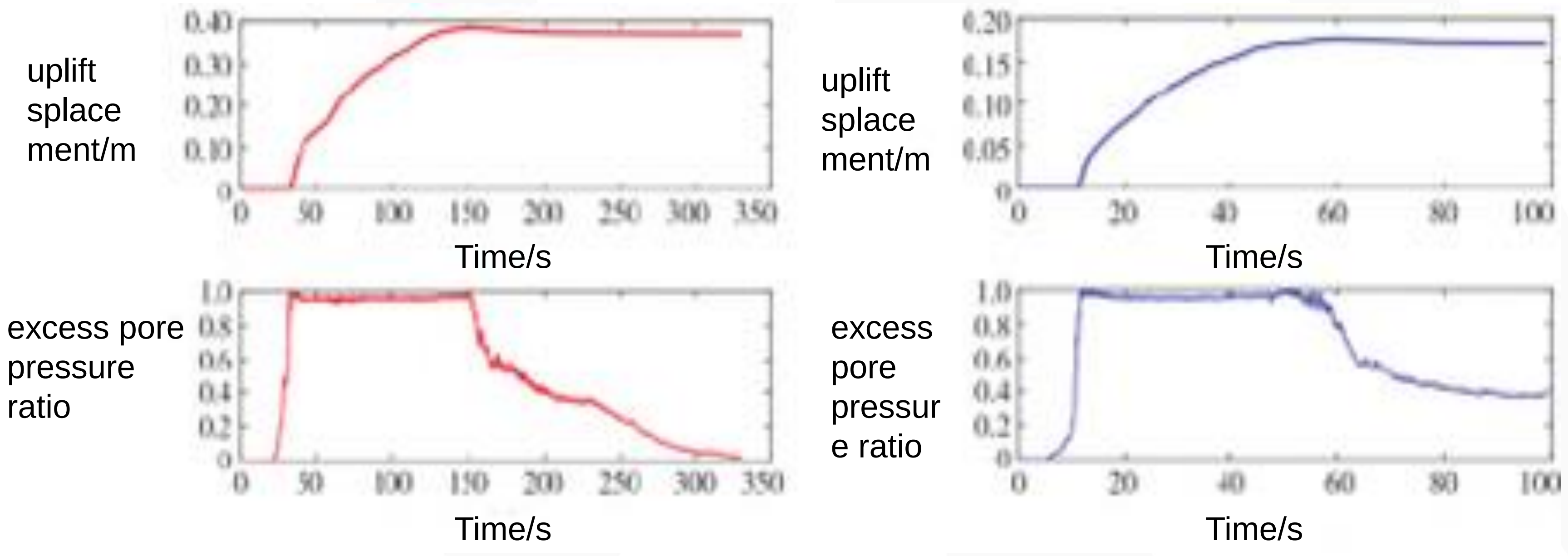
(a) empirical probability distribution
(b) average buoyancy

Fig. 3 Effect of pipe diameter on pipe uplift



(a) empirical probability distribution
(b) average buoyancy

Fig. 4 Effect of burial depth on pipe uplift



(a) long duration
(b) short duration

Fig. 5 Evolutions of ru for the monitor node A and uplift displacement of the pipe versus time